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FRENCH ARCHITECTURE  
From XI to XVI centuries

By  
EUGENE EMANUEL VIOLETT-LE-DUC  
Government Architect  
Inspector-General of Historic Buildings

Volume IV  
FRENCH ARCHITECTURE

PARIS

Translated by H. Clifford Barker, C. Arch.

American Professor of Architecture

UNIVERSITY OF ILLINOIS

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of

FRENCH ARCHITECTURE

From XI to XVI Centuries

By

EUGENE EMANUEL VIOLLET-LE-DUC

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Inspector General of Diocesan Edifices

Volume IX

From Tabernacle to Zodiacue

PARIS

Translated by N. Clifford Ricker. D. Arch.

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TABLES. Stonecutting.  
The altar was placed on the altar  
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the altar.

The altar was placed on the altar only dated  
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altar were placed in little altars placed beside the altar.  
or in a suspended case. (Art. Antel; also Art. Tabernacle in  
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had near the altar were of wood, stone or metal with a lantern  
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16th century are still seen in the churches of Belgium. These  
tabernacles of the only altar were often portable, and  
were only placed near the altar during divine service.

TABLES. Stonecutting.

Man says: "A good cutting, careless cutting, laid outside,"  
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The nature of the cutting is one of the most certain means for  
recognizing the date of a structure; but from the 12th cent-  
ury the different schools of stonecutters had proceeded that  
belonged to them, and that it is necessary to know to avoid  
confusion. Some certain provinces have adopted the toothed  
or have only employed those tools very late. Some stonecutters  
use only the narrow or broad chisel; some countries have al-  
ways employed the cutting axe without teeth and with more or  
less skill.

Note 1. p. 1. A tool with toothed edge.

As many facings of Roman edifices are made in perfection,  
being under the direction of Greek artists, so many surfaces  
of our Gallo-Roman monuments under the empire are neglected.  
Besides the Greeks, like the Romans, set out stone with clay  
clay joints and without mortar and roughed, they dressed the  
face when the work was executed. When they employed hard tools  
like like granite or marble, cutting was finished before setting.  
The many Greek monuments of our stone have remained untouched.  
For example, the temple of Sebaste and the great temple of  
Belinthe of the Doric order, exhibit at many places only a  
preliminary cutting.

As for Roman edifices of our stone, there exist very few  
that are not entirely dressed surfaces. The Colosseum, the



### TABERNACLE. Tabernacle.

A name given today to a little cupboard placed on the altar at the middle of the reredos, and that serves to deposit the PYX.

The establishment of tabernacles on the altars only dates from the last (18 th) century. Until the 17 th century the hosts were placed in little shrines placed beside the altar, or in a suspended case. (Art. Autel; also Art. Tabernacle in dictionnaire du mobilier francais). These little shrines placed near the altar were of wood, stone or metal with a lantern for placing a lamp. Some of those tabernacles dating from the 16 th century are still seen in the churches of Belgium. These reservations of the holy eucharist were often portable, and were only placed near the altar during divine service.

### TAILLE. Stonecutting.

Men say: - "A good cutting, careless cutting, laid cutting," to indicate the manner in which is treated a stone surface. The nature of the cutting is one of the most certain means for recognizing the date of a structure; but from the 12 th century the different schools of stonecutters had procedures that belonged to them, and that it is necessary to know to avoid confusion. Thus certain provinces have adopted the toothchisel,<sup>1</sup> or have only employed those tools very late. Some stonecutters use only the narrow or broad chisel; some countries have always employed the cutting axe without teeth and with more or less skill.

Note 1.p.1. A tool with toothed edge.

As many facings of Roman edifices are made in perfection, being under the direction of Greek artists, so many surfaces of our Gallo-Roman monuments under the empire are neglected. Besides the Greeks, like the Romans, set cut stone with clay clay joints and without mortar and roughed, they dressed the face when the work was erected. When they employed hard material like granite or marble, cutting was finished before setting. Many Greek monuments of cut stone have remained roughed. For example, the temple of Segeste and the great temple of Selinonte of the Doric period, exhibit at many places only a preliminary cutting.

As for Roman edifices of cut stone, there exist very few that are not entirely dressed surfaces. The Coliseum, the gate







Majore at Rome, the arenas of Nîmes and Arles, those of Pola, present only incompletely dressed surfaces. It is evident that when the structure was completed, they hastened to remove the scaffolds, and cared little to complete the dressing of the surfaces, or indeed this was done with negligence and haste, such that these surfaces retained a rude appearance.

It suffices to examine the numerous remains that we possess from the Gallo-Roman epoch of the late time, to prove the inferiority of cutting the surfaces, while the beds and joints are dressed with perfect precision; so well that the blocks of stone are accurately jointed, even in the monuments of a very late epoch. That negligence of the surfaces resulted from the slight importance that the Romans attached to form, and not to the lack of skill of the workmen. The preliminary cutting on the Gallo-Roman monuments is made by chisel drafts on the edges; the visible face of the stone retained its quarry dressing made with a narrow straight cutting. As for the beds and joints, they are cut by very fine chiseling at the edges and properly brought to a plane surface, the middle being made perfectly flat by a broad and fine cutting. Sometimes these beds and joints are rubbed, probably with a hard and rough stone, for example, such as millstone grit or lava. The use of lava for rubbing beds and joints appears to have been in use in Gaul, for where exist remains of Gallo-Roman structures, we have frequently found blocks of lava, although these provinces containing these remains are very distant from the volcanic country.

At the fall of the Roman empire, the knowledge of the stone-cutter was entirely lost. They further built only with roughed rubble, and the few blocks of cut stone found in the buildings are scarcely roughed. Yet a new fashion appears in the cutting of those rubble surfaces. The taste is well known, that the Indo-Germans had for interlaced lines. The jewels discovered in Merovingian tombs present a very great variety of those combinations of lines crossed, opposed and in groups, forming frets or chess-board patterns. In the Merovingian epoch are seen to appear the so-called herringbone cutting (Fig. 1), and this kind of strokes persists quite late among peoples preserving Germanic traditions. These strokes in groups are made by means of the broad and straight Roman tool. Until the







Carlovingian epoch, chiseling seems abandoned. Men no longer built with cut stone. On the contrary, we see chiseling employed everywhere in the stonecutting of the 8<sup>th</sup> and 9<sup>th</sup> centuries, the chiseling being done unskilfully, but still labored. During that epoch mouldings are entirely worked with the chisel. For the simple surfaces are rude, cut with the point and dressed with the wide flat chisel. In Burgundy and Charolais, provinces rich in hard stones, about the end of the 11<sup>th</sup> century appears a cutting very well done with the narrow flat tool without chiseling. Then the dressed stones were entirely cut before setting, with no facing afterwards; the custom adopted by the workman after the fall of the Roman empire, of building in roughed rubble, set on thick beds of mortar, had caused them to lose the tradition of dressing the surfaces after a setting. From the roughed rubble they came gradually to employ larger stones, and finally to cut stone, but continued to set it like rubble not surfaced afterwards; and they cut each block on the yard, taking care of the beds and joints as well as the surfaces. The structures of the 11<sup>th</sup> century still seen in Burgundy and on the banks of the Saone present beautiful surfaces, whose cutting in vertical lines on the flat surfaces and longitudinal ones on the mouldings are uniform everywhere, fine and close. In that epoch was frequently recognized the use of the lathe for columns and bases, and sometimes polishing for delicate mouldings within reach of the hands. About the same time in Auvergne, the cutting, although slightly heavier than in Burgundy and Charolais, is well done and regular, sometimes enhanced by chiseling on the mouldings. Before the 12<sup>th</sup> century in Isle-de-France the cutting is coarse and bad, recalling the Gallo-Roman monuments.

In Poitou, Berry and Saintonge, the cutting before the 12<sup>th</sup> century is extremely rude, done with a thick tool cutting badly and crushing the surface, allowing to be seen everywhere the strokes of the pick or point in roughing. Chiseling appears on the mouldings, but it is executed carelessly and by unskilful hands.

With the 12<sup>th</sup> century, at the moment when was felt in the West the influence of the Greco-Roman arts of Syria, cutting improved and very soon attained absolute perfection. In all the provinces, and notably in Burgundy, upper Champagne, Char-







Charolais and Saintonge, the advance is rapid and the stonecutters became singularly skilful. Then are seen to appear certain methods of treating the various cuttings: the plane surfaces are dressed with the flat tool, while the mouldings are cut with the chisel and are often rubbed. The use of the tooth chisel begins to be seen on the banks of the Loire, in the Chartres country and the royal domain. About 1140 that tool seems to be in general use in the provinces north of the Loire, while it does not appear yet in Burgundy and in the entire South of France. Cutting with the tooth chisel only shows itself in Burgundy about 1200, and only appears 50 years later on the banks of the Saone and Rhone, in Auvergne and Languedoc. The choir of the abbey of Vezelay, which dates from the last years of the 12 th century, and which presents cutting so marvellously executed, shows at the same time the use of the very fine straight tool, of the chisel and of polishing, and in some parts, of the tooth chisel with wide teeth. The bases, abacuses of capitals, mouldings of bands, are polished with incomparable purity and execution. The same execution in the church of Montreal of the same epoch. These differences in the nature of the cutting produce much effect and give particular delicacy to the mouldings. From the 13 th century the school of Ise-de-France, which takes the lead in the art of architecture, employs only the tooth chisel, but it frequently polishes the mouldings within reach of the hand, as well as the bases of the columns. This fact can be observed at Notre Dame of Paris, Notre Dame of Chartres, the cathedral of Troyes, S. Quiriace of Provins, S. Chapelle of Paris, and in a great number of other monuments.

During this time in provinces where red sandstone abounds, in the Vosges and on the banks of the Rhine, men continue to dress with the point, the broad chisel and the wooden mallet. One sees much cutting of this kind at Strasburg, where the same tools are used today. In the cathedral of that city is noted a great variety of cutting from the 11 th to the 14 th centuries, obtained with the same tools. Thus in the crypt of that monument, at the north side is seen cutting done with the point, which gives this design (Fig. 2). On the vaults of the same crypt (12 th century), the cutting is done in groups by the aid of the broad Strasburg chisel (Fig. 3). The church of







Rosheim near Strasburg (12 th century) presents externally and internally surfaces cut with the broad chisel, as indicated by Fig. 4. It must be stated that the red sandstone of the Vosges can hardly be surfaced, except by the wide chisel, and the stonecutters of that province take a certain pride in producing cuttings with such regularity and fineness as permitted by the nature of the materials. In Isle-de-France our stonecutters in the 13 th century not only cut the surfaces, but also the most delicate mouldings with the tooth chisel, which requires great skill of hand. This tool (the tooth chisel) has finer teeth as the mouldings become more delicate. In the 14 th century these mouldings often have such slenderness, that the tooth chisel cannot make them; then is employed the tooth scraper, a sort of curved chisel with very fine teeth, used perpendicular to the moulding (Fig. 5). Thus the stonecutter models his moulding as would an engraver, to make the different curve felt. The scraper is the tool solely employed in the 15 th century to finish all mouldings, and the tooth chisel is only used for flat surfaces.

In provinces in which are only very hard stones, such as certain Jurassic limestones, sandstone, lava and even granite, men continued to use the point, chisel and flat chisel. The tooth chisel, and for a greater reason the tooth scraper, do not have sufficient power to work those materials. All the mouldings are separated by the chisel and finished by the very narrow flat chisel used lengthwise. No traces are seen of the tool called "boucharde" except on certain monuments in the South and built of hard sandstone, for example at Carcassonne, and that tool appeared only very late, about the end of the 15 th century. Still it is not quite certain that it was made like that too frequently employed today. It was a sort of great tooth chisel with teeth blunt instead of cutting. Until the end of the 15 th century, stonecutting in France is done with great perfection, frequently with complete knowledge of the form and effect to be obtained. Plane surfaces are never treated like mouldings. The marks of the tooth chisel and later of the large scraper appear on those surfaces, while scarcely visible on the moulded parts. Polished details then also give variety and value to this cutting.

With the 15 th century, too frequently carelessness, unifor-





uniformity and unintelligent work replace the qualities of the cutting prominent on our old edifices. Then since the middle of the 15<sup>th</sup> century, men only employed in the work soft stones of fine and compact grain, like the stones of Vernon, Tonnerre and the densest from S. Leu. It was no longer possible to use the tooth chisel on those materials, but coarse and fine scrapers. These tools have the inconvenience, particularly for plane surfaces, that if the workman does not have a light hand, of cutting deeper into the soft parts and refusing to attack those harder. It results that the scraped surfaces are wavy and produce the worst effect under the light just touching them. Men then rub sandstone on those surfaces and make them plane, and this operation effaces the cutting, taking from it that warm grained surface, that so happily catches the rays of the sun. The mouldings and plane surfaces assume a uniform appearance, cold and soft, that gives a stone edifice the appearance of a structure covered by stucco.

TAILLOIR. Abacus. Article Abaque.

TAPISSERIE. Plane surface of stone.

Name given to all plane surfaces of stone, either in the interior or on the exterior of an edifice. Men say: - "the plane surfaces (tapisserie) are well cut, to indicate that the surface is well made, plane, well faced or plastered.

TAPISSERIE. Fabrics for Hangings.

See Dictionnaire du mobilier français.

TAS. Structure. Construction.

Entirety of the work where are set the various materials prepared on the yard.

TAS DE CHARGE. Horizontal Courses over Piers, Columns, etc.

Courses of stone with horizontal beds placed over a point of support, on a pier or an angle of a wall between arches, to receive the upper construction. Also said of certain corbellings, as for example of the series of corbels that receive the buttresses of a curtain or tower (Art. Machicoulis).

One easily conceives that when several arches rest on the





top of a pier whose section is not large, the inclined beds of the voussoirs a (Fig. 1) do not present a bearing suitable to receive an upper load b. This tends to cause these voussoirs to slip or to crush them, because they present the angle of their extrados under its vertical action. Then (see B) in well understood constructions, where are left between the extradoses of those voussoirs horizontal courses c between the curves of the arches, or if space does not permit, there is placed a series of imposts d (see at C) with horizontal beds. (Art. Construction, Figs. 46, 46 bis, 48 ter, 49 bis, 81, 96 and 127). Sometimes the constructors of the middle ages have formed arches entirely composed of horizontal courses to avoid thrusts under a considerable load. Thus are jointed archivolts of the great openings of the two western towers of the cathedral of Rheims, so as to support the stone spires projected for those towers.

The absence of horizontal courses over piers has occasioned their crushing. This is found quite frequently in the structures of the end of the 12 th century. It is clear that if one joints the arches over a pier as drawn at a (Fig. 2), all the weight of the upper construction, sliding along the extrados of those arches, forms a wedge at b and exerts at that single point a pressure, that should have been distributed over the entire area of the pier. Arches near the crown e tend to crush at d and may be dislocated, only imperfectly abutting against the wedge of pressure. This only rests on its edge, and is crushed, and the pressures acting very irregularly on the pier, break the courses. This accident is quite frequent, as we have just stated, in buildings erected in the 12 th century, when men had not acquired complete experience of the effect of great vaulted constructions resting on slender points of support, and must attract the attention of architects charged with the restoration of those structures. Frequently on perceiving crushed piers, although of important sections, one believes the insufficiency of the material employed, and is contented to replace the broken courses: that is the effect; but the cause is almost always in the imposts, that have no horizontal courses or beds above the capitals at the springing of the arches. It is then urgent to suppress this cause. The operation is of often dangerous and requires attention. To replace the crushed





courses of a pier in this case without starting anew with horizontal imposts with horizontal beds instead of voussoirs arranged as above, is to do useless work.

The accidents produced in edifices of the 12 th century by the absence or insufficiency of the horizontal courses were not lost upon the masters of the 13 th century. They soon came, as we demonstrated in Art. Construction, to give radial beds to the voussoirs only when their extrados left the vertical of the upper load (Fig. 3). This principle being once adopted, they derived numerous results from it; they frequently succeeded in almost completely neutralizing the thrusts of arches on walls, or in diminishing considerably the volume and weight of the masonry intended to abut these thrusts.

The theory of that principle is this (Fig. 4); let there be a nave A with a cross vault, with triforium B and gallery C above at the springing of the great vaults, with side aisle D likewise with cross vaults. It is necessary:— 1, not to crush the cylindrical piers E; 2, not to have a considerable volume of the piers F of the flying buttress. The buttresses G are erected with a projection sufficiently pronounced to present not only a sufficient abutment for the vaults of the side aisle, but also a bearing sufficiently wide to resist an unequal pressure. The courses H of the buttress are cut horizontally at the springing of the transverse and diagonal arches of the vaults of the side aisles, so as to receive on their horizontal beds the overhand of the pier F at K. Likewise at L the courses at the springing of the flying buttress M are cut horizontally to receive the overhanging pinnacle N. The dotted line N O being vertically over the internal surface P, it is clear that if the flying buttress M did not exist, the entire system of the abutting pier would be in equilibrium with a tendency at the least movement, to overturn at L. Thus this pile of courses tends to incline towards the great vault, and consequently to exert a pressure on it. The flying buttress transmits the pressure. Above the pier or column E, the courses are cut with horizontal courses at R, and receive the pier S on horizontal beds. The impost curves of the transverse and diagonal arches of the great vault T are cut with horizontal courses to transmit the pressure of the voussoirs to the pier V and the column E. Thus by the aid of these horizontal courses





is obtained the equilibrium of the general system. It is due to the equilibrium of the pier F, tending to incline toward the interior of the edifice, that the abutment of the flying buttress can be sensibly reduced. The capital of the pier E projecting more toward the nave than toward the side aisle, thus has its axis beneath the resultant of the pressures of the great vault, a resultant nearly vertical by the abutment of the flying buttress. The horizontal courses R also have the effect of preventing the thrust of the vaults of the side aisles, of bending the piers E toward the interior, in transferring the resultant of the pressure of these vaults to the axes of these piers.

According to this theory was constructed the very interesting church of Notre Dame of Dijon. Unfortunately the execution was careless, executed with too much parsimony and by workmen that did not perfectly understand the system adopted, leaving too much to be desired. Its conception is no less very remarkable and is due to a learned master. By making the execution accord with the theory, this monument could be restored without too much effort. It is unnecessary to believe that these structural combinations injure the effect, for certainly the church of Notre Dame of Dijon is one of the most beautiful monuments of Burgundy. There even results from this system of equilibrium a freedom of method, and clearness, that charms the least experienced eyes.

The masters of the 14<sup>th</sup> and 15<sup>th</sup> centuries were very wise constructors, and did not neglect to employ horizontal courses, and they comprehended their importance so well, that they took care to cut them in very high courses to suppress the chances of rupture. But in Art. Construction will be found numerous examples of the use of this system of jointing.

#### TEMPLE. Commandery of Knights Templar.

Nine knights, companions in arms of Godfrey de Bouillon, vowed before Garimond, patriarch of Jerusalem, to consecrate themselves to the holy land.<sup>1</sup> Living on alms, vowed to celibacy, devoting every instant of their lives to the protection of pilgrims, to destroy brigandage and to fight the infidels, they obtained from Baldwin II, king of Jerusalem, permission to live near the temple in a dependency of the palace of that





prince. Hence they were called Templars, knights of the Temple, or also soldiers of Christ. (Christi milites).

Note 1.p.12. These nine knights were; Hugues de Payens, Godfrey de S. Omer, Andre de Montford, Godfrey, Borel, Godfrey E Bisol, Payen de Montdesir, Archambard ed S. Aiglon, or according to Lejeune, Hugues, count de Champagne, founder of Clotroux.

Those first knights of the Temple were subject to the rule of S. Augustine. Having been permitted to obtain a special constitution by Pope Honorius II, that pontiff referred them to the council of Troyes in 1128, where S. Bernard composed for them a fixed rule, that was adopted. Soon this order became one of the richest and most powerful in Christendom. In the time of William of Tyre, the commandery of Jerusalem counted 300 knights and a larger number of serving brothers. Commanderies arose on the entire area of the West, besides the establishments of Palestine and Syria. From the 12 th century, the Templars possessed castles, strong places, lands in prodigious number, so much that Father S. Honore of S. Marie estimates that the revenues of the order rose to the sum of 54,000,000 francs.<sup>2</sup>

Note 2.p.12. See Histoire des chevaliers templiers, by Elise de Montagnac. Paris. 1864.

During the middle ages, the name of temples was given to the chapels of the commanderies of Templars; these chapels were habitually built on a circular plan in memory of the holy sepulchre, and were quite small. It is well understood that the earliest chapels of the Templars date only at about the middle of the 12 th century, and nearly all were built at that epoch.

After the abandonment of Jerusalem by western men, the chief residence of the Templars was at Paris. The commandery of Paris comprised vast lands, whose area equaled a third of the capital; it was founded about 1148, or according to Felibien, on the return of Louis VII from the crusade. At the time of the trial of the Templars, i.e., in 1307, the buildings of the commandery at Paris consisted of the primitive circular chapel of the 12 th century, that had been inclosed in a nave of the 13 th, and a tower belonging to that nave, and of spacious buildings for lodging and receiving the hospital brothers. M Matthew Paris relates that Henry III, king of England, on his journey to Paris in 1254, lodged in the commandery, where arose numerous and magnificent buildings intended for the knights,





for holding the general chapters, for it was not permitted to them to lodge elsewhere. <sup>1</sup> In 1306, a year before the abolition of the order, the keep was completed; it had been commenced under the commander Jean le Turc (John the Turk). This keep consisted of a very high square tower, flanked at the angles by four turrets rising from the ground, containing stairs and watchmen. <sup>2</sup> The extent, beauty, richness and strength of the commandery at Paris instigated the accusation brought against them. In fact, the preceding year in 1306, the king Philip the Fair took refuge therein during the riots against the counterfeiters, and from that fortress he could await without fear the exhaustion of the popular rage. He then thought of appropriating to himself a safer residence, one more vast and splendid than were the palace and the Louvre.

Note 1.p.13. See Dubreuil, *Theatre des antiquites de Paris*. Book III.

Note 2.p.13. In this keep Louis XVI was imprisoned in 1792.

The magnificent hospitality given to princes by the Templars, possessors of considerable wealth and wisely governed, could not fail to excite the cupidity of a sovereign as Philip the Fair. Later the hospitality that Louis XIV was willing to accept at Vaux was no less fatal to the superintendent Foucart.

The last knights of the Temple, who left Palestine and returned to the West 50,000 gold florins and considerable portable wealth. These treasures were only increased in their commanderies by an administration subject to a strict control. The mystery surrounding the deliberations of the order could further only exaggerate the opinion held concerning their wealth. As soon as they had been condemned and executed, Philip the Fair established himself at the commandery. As for the treasures, they passed into his hands and those of Pope Clement V, accomplice of the king in the iniquitous and scandalous procedure. Later the commander of Paris and the commanderies of France were given to the knights of S. John of Jerusalem, <sup>3</sup> then of Rhodes and Malta.

Note 3.p.13. Only in 1317 by a transaction between the knights hospitallers and Philip the Toll, it is proved that the sequestration of the property of the Templars was prolonged until 1313. Thus the crown had lost during a period of six years the enormous revenues of this property; and further,





all of the portable property and treasures remained in the hands of the king.

Sauval<sup>1</sup> expresses himself thus on the subject of the temple: "It is a Gothic church, accompanied before the doorway by a little porch or old vestibule, and on entering is enriched by a dome, whose vault is that of the nave, and is supported by 6 great piers that bear the arches in the first story and as many piers in the second, which rise to the springing of the vault. This dome is surrounded by an aisle, whose vault is at a height equal to those arches. That entrance part is unique in its kind that I have seen in France, England and the 17 provinces, not only is it majestic and magnificent inside, but also it produces a surprising and pleasing effect by the view outside."

Note 1.p.14. Book IV, p. 454.

"The circuit of this place," says Corrozet,<sup>2</sup> "the Temple, its dependences and gardens is very spacious, and larger than many a famous city of this realm; it is enclosed by strong walls with turrets and wide galleries for two men to walk in front. There are several chapels and lodgings in ruin, that serve for the meetings of the Templars, each with his nation. There are also several rich new buildings built by the knights of Rhodes, to whom was given the property of the said Templars, and consequently the said place of the Temple, whose church is built in the image of the temple of Jerusalem."

Note 2.p.14. Antiquitez de Paris, by G. Corrozet, Parisien. 1586. part 1. p.108.

Collecting all the information that we have been able to procure on the Temple of Paris,<sup>3</sup> we give the plan of the church (Fig. 1). The rotunda dates from the first half of the 12th century. After the Templars left Palestine, this rotunda was enlarged by the porch A, mentioned by Sauval, and a little later by the great nave B. The bottom of the tower C likewise dates from the 12th century, and the belfry story from the beginning of the 13th century.

Note 3.p.14. See the plan of Paris by Verniquet, the engravings of Israel Sylvestre, and the work of Morot, L'architecture française.

The porch A was open in its lower part and glazed in the upper. This arrangement was frequently adopted for cloisters





and produced a very picturesque effect here, as Sauval remarks. A longitudinal section (Fig. 2) shows the original arrangement of these structures added to the primitive rotunda. At A is the porch with its lateral openings; above being the glazed windows. This is nearly the arrangement remaining at Aix-la-Chapelle, but better understood. The internal rotunda had retained its vaults and its upper story, that externally projected beyond the walls of the narthex and of the great nave.<sup>1</sup> The equilateral triangle was the generator of the plan of the rotunda. It is known that the equilateral triangle was one of the signs adopted by the Templars. Fragments of glass furnished by M. de Penguern, and taken from the chapel of the commandery of Brelvennez, allow one to see the red cross surrounded by the golden orle of the Templars and the equilateral triangle. In the chapel of S. George of Cheac'h near S. Briec, are placed several tomb slabs of knights of the Temple. On one is engraved a small Latin cross, and below is a sword placed diagonally; between the sword and the cross is an equilateral triangle.<sup>1</sup>

Note 1.p.16. Histoire des chevaliers templiers, by Elize de Montagnac. Paris. Aubry. 1864.

The freemasons have pretended to continue the order of the Temple and even to possess a testament or charter of transmission from the grand master, whose secret authority was recognized by the brothers after the death of Jacques de Molay.

It should not be forgotten that the founders of the order of the Temple were nine in number (square of 3), and that these were not permitted to ordain new brothers till after 9 years, and that the numbers 3 and 9 appear frequently in the chapels of the commanderies. The great rotunda of Paris had 6 internal piers and 12 bays externally (Fig. 1). Its plan could only be obtained by two equilateral triangles intersecting each other, as indicated by Fig. 3.

The chapel of the commandery of Laon, that dates from about the middle of the 12th century, is an octagon whose sides internally are 9 ft. long. This chapel (Fig. 4) appears to have been built at one spurt, except the apse, that may have been a little later. It possesses a porch or narthex with gallery above, built afterwards, and which was in communication with the barracks of the commandery. The walls of the octagon are





3 ft. thick and the buttresses are 3 ft. wide. One course of stone benches is arranged at the base of the internal walls. Here (Fig. 5) is the longitudinal section of that chapel. The vault is constructed with sides and with projecting ribs under the reentrant angles.

The arrangement of these little chapels with a sanctuary of little importance, sufficiently indicate that the knights of Christ or of the Temple did not admit the public during the religious ceremonies. These chapels also served as a place of assembly for deliberations, that ordinarily were held at night. Besides extreme sobriety of ornamentation, these little monuments of the 12 th century show the influence of the abbot of Citeaux, who drew up the statutes of the order. This simplicity is found also on the tomb slabs still found in these edifices; without inscriptions, they show only the cross of the order, a sword, triangle or some attributes, very rarely heraldic shields.<sup>1</sup> In the chapel of Laon, three of these tombs exist at the entrance of the sanctuary; they are ornamented by engraved pattee crosses.

Note 1.p.18. One of the tombs of the chapel of the commandery near the hamlet of Creoch presents an ancree cross with a sword at the left and shield on the right with 7 coltrops, 3, 3 + 1, which is that of Rohan Sr. (*Histoire des chevaliers templiers*, already cited, p. 135).

The Templars possessed in Syria and the West a great number of castles and fortresses.<sup>2</sup> Compelled to leave the holy land after the siege of Acre in 1291, they returned to France, England and Spain, where they possessed commanderies, and bringing with them great wealth in spite of the misfortunes of their order, they employed those treasures in enlarging and embellishing their residences; their leisure in forming in the already declining feudal State a compact and powerful association, occupied in diplomatic intrigues, and haughty, with which all persons must reckon. Their great possessions, administered with economy at an epoch when all landed proprietors and the sovereigns themselves always lacked money, allowed them to lend important sums; it is to be believed that these were not without interest. Such a situation created numerous and powerful enemies, and the day when Philip the Fair, who was among their debtors, decided to cause their arrest, and to





bring against them the most iniquitous and most monstrous lawsuit, the king had with him the opinion of the feudal nobles, the clergy and monastic establishments. The mystery surrounding the Templars lent itself marvellously to the absurd accusations to which they were exposed. It is certain that the orders of Templars, Palestine being lost, became for the States of the West a great embarrassment, if not a great danger. The act of the State suppressing this order delivered the sovereign power from one of the numerous dangers that surrounded it, but took from it in the opinion of the people a part of the faith in its justice and its moral grandeur, that Louis IX had known how to impose on all classes in the country.

Note 2.p.18. Among the important castles that the Templars had built in Syria, we shall cite those of Tortoso (Antarous), Safita, Areyneh, Toron and Athlit. These castles generally contained a great square or rectangular keep, and their enclosing walls were likewise flanked by rectangular towers. "The castles of Safita, Areyneh, Athlit, and particularly the fortress of Tortoso," says M. G. Rey in his *Essai sur la domination françoise en Syrie*, "furnish us with a series of types permitting the giving of a study as complete as possible of this art, whose best productions are found in the principalities of Antioch and of Tripoli, so rich, and especially the first, in Byzantine monuments." Tortoso on the seacoast was the last place occupied by the Templars in the Orient. They only evacuated that fortress on June 5, 1291. In the West the Templars likewise adopted the square or rectangular plan for the construction of their keeps. On that principle was built the tower called Bichot, that was destroyed only in 1855. (Art. Tour).

#### THEATRE. Theatre.

During the middle ages no places existed intended for scenic representations. The mysteries, farces and mummeries, ballads recited by actors, were represented in the great halls of castles, churches and cemeteries, or on scaffolds built at street crossings, as practised at fairs. Only in the 17th century did men begin in France to erect halls designed solely for scenic plays. The taste for the theatre, however, dates back to an early epoch, and there exist mystery and morality plays, that date from the end of the 12th century.





**TIERCERON. Rib of Vault.**

Rib of a pointed vault turned between the transverse and side arches and ending at the lierne rib, which connects the crown of the transverse or side arch with that of the diagonal arches. (Art. Voute).

**TIRANT. Tie. Tiebeam or tierod.**

An iron rod or a timber that limits the span of the principals of a truss, or the distance between two parallel walls, or resists the thrust of an arch. The tiebeams in the carpentry of roofs are actual ties. (Art. charpente). To cose their vaults, the constructors of the middle ages temporarily placed ties to avoid thrusts while waiting until the piers were loaded. These ties were generally timbers, and were sawn off flush with the intrados of the impost of the arches, when the construction was completed. At the cathedral of Rheims these ties were of iron with eyes hooked on hooks remaining in place. Few vaults of side aisles do not give opportunity for observing the traces of these ties.

**TOILES, (Peintes). Painted Hangings.**

Men frequently employed during the middle ages painted fabrics for hanging the interiors of apartments and for decorating great halls and churches. The treasury of the cathedral of Rheims still possesses a certain number of painted fabrics of the end of the 15 th century, that are of great interest. These fabrics were attached to frames in the interiors of castles and of mansions, or simply suspended from the closets or cabinets improvised in great rooms were often composed of simple frames of wood hung with painted fabrics. (See Dictionnaire du mobilier francais).

**TOMBEAU. Tomb. Grave.**

Of all monuments, tombs are those that perhaps present the most extensive subject in the studies of the archaeologist, ethnologist, historian, artist and indeed of the philosopher. Civilizations on all steps of the ladder have manifested the nature of their belief in another life by the manner in which they have treated the dead. Suppress all idea of the duration of the individual beyond the earthly existence, and the tomb





no longer has a reason for existence. Now from the superior races of the blacks of South Africa, we see in all times men bury their dead with a more or less clear idea of a prolongation or transposition of existence. One could write the history of humanity by the aid of the tombs, and the day when a people ceases to perpetuate the individuality of the dead by a monument, or some mark, society will cease to exist, at least such as continued during historical times. The worship of the dead is the cement that constituted the first societies, made of them permanent institutions and nationalities, i.e., the connection of the present with the past, perpetuity of tendencies, aptitudes, desires and regrets, hatreds and vengeance. Let the dead of a people be confused with an administrative routine of sanitation, and be treated decently, but like material whose decomposition must be treated to restore the elements the soonest possible to inorganic nature, as manure is treated; do only that among customs and nationalities, and those traditional combinations, powerful and living, will be no more than societies formed for a term of years, unless it is assumed that the most abstract metaphysical ideas of the existence of the soul are commonly accepted, as they can be by half a dozen philosophers in a country with several millions of inhabitants. It will be very difficult to cause to be accepted an absolute indifference for the perishable remains of a woman that has been loved, respected or known. And in our great cities, if there be one thing that shocks the popular feeling, it is called the common grave.

Only since the 16<sup>th</sup> century has one thought to give to burials a funereal character; to surround them with emblems, attributes or allegories that recall the end, the decomposition, the sorrow without return, destruction, darkness and oblivion, nothingness. It is very singular that those ideas daily appear among peoples, who pride themselves on being Christians, and among whom the pulpit shows death as a deliverance, as the end of the miseries attached to the brief earthly existence. By contrast, the pagans have given to sepulchral monuments a character rather triumphal than distressed. The middle ages retained that same tradition, the tombs that it erected never adopted those funereal attributes brought into fashion since the 16<sup>th</sup> century, those theatrical effects or cold allegories,





that always require the presence of a guide for explanation.

Death should not so disquiet people, since everyone must submit to its law; it seems unnecessary to surround it with all that frippery of melodrama, ungraceful and ridiculous. At the end of the Renaissance were erected the first mausoleums decorated by funereal allegories from diseased brains; bones of the dead, shrouds lifted by skeletons, corpses eaten by worms, etc. The art of the grand century could not fail to find that very beautiful, and the 18<sup>th</sup> century even increased these poverties. These middle ages that some always present to us as unhealthy, ascetic and melancholy, did not so take the matters of death, no more than the Greeks and Romans. As well known, those had the habit of burning the corpses, which had many advantages. Along the roads radiating toward the cities were erected tombs. This arrangement alone indicates sufficiently, that for those pagans burial did not produce those dismal ideas, that seize on us today in cemeteries. Those streets of tombs surrounding the suburbs of Rome did not prevent passers on the roads from entertaining less serious subjects, without causing the respect for the dead to be less profound. During the middle ages the cemeteries were not more seen from the dismal and romantic point of view. The middle ages had no fear of the dead, no more than in antiquity. If the Greeks loved to sit and chat at the foot of the tomb placed beside the road, our ancestors voluntarily assembled in the cemeteries to treat certain affairs. At night those enclosures were indicated by a beacon, and at need served as a refuge to the traveler, who did not think of returning spirits, at least in our French provinces. Those cemeteries were nearly always surrounded by a low portico, and under that shelter the poor and the delayed traveler awaited the day, when he could no cause the gates of the city to be opened.

We shall not undertake the description of Gallo-Roman and Merovingian cemeteries. This work was well done for a part of France by Abbe Cochet,<sup>1</sup> and will dispense with our speaking of the tombs of the first barbarous conquerors of Gaul, the more that those sepulchres assume no architectural appearance. These are burials in coffins of wood, stone, or even in earth, which have no interest except from the point of view of archaeology.



The first of these was the discovery of a small, dark, rectangular object, about the size of a matchbox, lying on the ground. It was found by a patrolman who was walking the beat. The object was picked up and taken to the station. It was found to be a small, dark, rectangular object, about the size of a matchbox, lying on the ground. It was found by a patrolman who was walking the beat. The object was picked up and taken to the station.

about the middle of the 12th century. They also dated the discovery of the object and in adjacent places were found. The object was found by a patrolman who was walking the beat. It was found to be a small, dark, rectangular object, about the size of a matchbox, lying on the ground. It was found by a patrolman who was walking the beat. The object was picked up and taken to the station.

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in a house or a small building. It was found by a patrolman who was walking the beat. The object was picked up and taken to the station. The object was found by a patrolman who was walking the beat. It was found to be a small, dark, rectangular object, about the size of a matchbox, lying on the ground. It was found by a patrolman who was walking the beat. The object was picked up and taken to the station.

Note 1.p.22. La Normandie souterraine, by M. Abbe Cochet. P  
Paris. 1855.

It appeared that the custom of building tombs along the public roads was not entirely abandoned during the Merovingian period. Gregory of Tours cites several examples of this sort of monuments. <sup>1</sup> Later under the first Carolingians, important personages preferred to be buried beneath the eaves of churches, chapels or oratories. <sup>2</sup> This custom persisted until about the middle of the 12 th century. They also buried under the porches of churches and in adjacent places that were blessed. It was only at the end of the 12 th century that was established the custom of burial in the churches, and of erecting monuments or of engraving memorial slabs over the graves.

Note 1.p.23. Bishop Arouetius "having returned to the city of Maestricht, was there attacked by a light fever of which he died. His body was washed by the faithful, and was interred near the public way." Hist. Franc. Book. II. Chap. 56

Note 2.p.23. Old French poem. Roman de Rou. Verse 5879 etc.

Contrary to the custom adopted among the Greeks and Romans, the first Christians did not burn the bodies, but they buried them in recesses made in the walls of crypts, or in sarcophaguses of stone or marble. If the persons were important, these sarcophaguses often remained visible in subterranean rooms; they were decorated by symbolical sculptures or religious signs, the cross, monograms of Christ, doves, etc. They were generally placed on plinths or little columns to isolated them from the earth. These sarcophaguses consisted of an oblong rectangular case with cover in the form of a roof with two slopes or segmental. The body of the deceased was placed in that case. <sup>3</sup> The tombs of the middle ages proceeded from that principle. But about the middle of the 12 th century was placed on the lid the effigy of the dead, and then the sarcophagus was most commonly a mere imitation, and the body was placed under it in a grave or a little cell. It was also about this epoch that men were often satisfied by placing on the buried coffin an engraved slab or bronze plate representing the deceased. The principal part of the tomb, the sarcophagus or rather its imitation was soon merely an accessory, the real slab bearing reclining figures, and besides these statues, the monument consisted of elevated canopies or a sort of chapel in form of





a wide niche.

Note 3. p.23. We found in the abbey church of S. Denis beneath the pavement of the basilica of Dagobert several sarcophaguses of stone, wider at one end than the other. On the lid and on an end of only one of those sarcophaguses are rudely incised pottee crosses; the other sarcophaguses are plain. These contained bones entirely reduced to dust, traces of fabrics and threads of gold that were in the cloth, and some bronze tips of leather. (Deposited in the museum of Cluny). Several of these bodies were interred without heads, which causes one to suppose that the skulls were separately placed in shrines.

The tombs of the middle ages can then be divided into three series; the first comprises the sarcophaguses, properly so-called, more or less ornamented by sculptures, but without a representation of the deceased; visible sarcophaguses placed above ground; the second being the socles placed over a grave, sometimes bearing the effigy of the dead, and placed either in a sort of niche or little chapel, or under a shrine in the form of a canopy; the third being the flat tombs placed at the level of the pavement of churches, engraved or in relief, forming the cover of the grave containing the coffin.

Sarcophaguses actually containing the body without an effigy are rarely found after the 12 th century, but are very numerous during the Merovingian and Carolingian periods.

Here (Fig. 1) is one of the forms assumed by those sarcophaguses.<sup>1</sup> During the 11 th and 12 th centuries rectangular sarcophaguses were still hollowed out, as during the Gallo-Roman period, with reliefs sculptured on the surfaces. We will cite among others the sarcophagus of S. Hilaire the Great of Poitiers, drawn by Gaignieres (Collection Bodleian), and which dates from the 11 th century; those of the counts of Toulouse, placed against the wall of the south transept of S. Sernin of Toulouse, 11 th and 12 th centuries. The latter were placed on little columns in a sort of little external chapel about the end of the 12 th century. In the southern provinces, Provence, Languedoc and Lyonnais, the custom of depositing the corpse in marble sarcophaguses long persisted; it was an ancient custom retained among these peoples. In the museum of Toulouse are seen sarcophaguses of the 14 th century, that absolutely take the form of the Roman sepulchral tubs, but





which are decorated by ornaments and attributes belonging to this advanced epoch of the middle ages.<sup>2</sup> The bodies were evidently enclosed in those cases; while in the provinces of the North, as we have previously stated, they were interred beneath the imitation sarcophagus, which was then a cenotaph.

Note 1.p.24. A is the top and end of one of those Merovingian sarcophaguses of S. Denis; B is the sarcophagus of S. Andoche (*Hist. de Bourgoëne*, by Dom. Planchet. Vol. II, p. 520); C is the lid of a sarcophagus in the church S. Hilaire of Poitiers, 8<sup>th</sup> century.

Note 2.p.24. On the sarcophaguses of the last time of the Roman empire one very frequently seen sculptured representations of hunts. This tradition again recurs in the funerary monuments of the 12<sup>th</sup> century. There exists at the museum of Mort among others a sarcophagus of that epoch, on the lid of which are represented a lord and his wife on horseback, hunting with falcons, then among trees is a man holding trap nets for taking birds, an archer, dogs and horses.

The sarcophagus becoming a cenotaph, it was natural to cover it by a canopy or arch, to make it an honorary monument, to regard it as a state bed on which was placed the effigy of the deceased.

The artists of the middle ages applied in the composition of tombs the logical spirit, that we find in their works. For them the tomb was the perpetual exhibition of the deceased on his state bed. What was done during some hours before the burial, was represented in stone or marble, to reproduce to the eyes of the public the funeral ceremonies in all their pomp. But with this idea was mingled a feeling that excluded realism. Angels bearing censers support the cushion on which rests the head of the dead. On the side of the sarcophagus are sculptured the mourners and confraternities, sometimes the patron saints of the deceased, or angels. It is the assemblage poetized. We shall at once present examples of those arrangements.

A curious monument explains to us the origin of these cenotaph tombs with the exhibition of the deceased. This is a capital of the western porch of the church of S. Severin (commonly called S. Sernin) of Bordeaux. This porch dates from the beginning of the 12<sup>th</sup> century. One of its engaged columns is crowned by a representation of the tomb of S. Severin, forming a





capital beneath the impost of a transverse arch. The body of the saint is wrapped in a shroud (Fig. 2), has a cross at its left side, and is placed on a sort of state bed supported by little columns; <sup>1</sup> on the sides of this bed is engraved the following inscription. <sup>2</sup> On the front; + Saint Severinus. ++

On the right side; this stone signifies the sepulchre of S. Severinus.

On the left side; when he passed to the ages. M.

Note 1.p.27. On the sarcophagus of S. Hilary the Great of Poitiers is represented likewise the body of the saint placed on a sort of state bed; the archangel Michael is placed at one side, a second angel at the other; then come several personages, saints and persons present. In the crypt of Aix-la-Chapelle, the body of Charlemagne, embalmed, was placed on a throne, clothed in his vestments, the crown on his head and a sword at his side.

Note 2.p.27. Due to the care of M. Durand, architect at Bordeaux, who had that inscription engraved, it has been possible to read it. -- See the Notice on that monument published by M. Durand. (Bordeaux. 1844).

To avoid confusion in this Article, we shall pursue the examination of tombs by retaining the classification just indicated.

As one of the most ancient tombs attached to religious monuments may be regarded the tomb seen at Toulouse between the buttresses of the buildings of the Carthusians, This monument of the 12 th century is well preserved, and consists of a sarcophagus placed in a recess elevated above the ground on little columns. An open arcade protects the sarcophagus. Fig. 3 presents the plan of this tomb, and Fig. 4 is its elevation and section. The little columns are of marble as well as the sarcophagus, the arcade being of stone, and the rest of the construction is of brick. This tomb was entirely painted. It is not known for what personage it was erected, but it is very certain that here the body was placed in the sarcophagus itself, resting on 5 little columns above the substructure, according to the custom still adopted in the 12 th century in the southerly provinces, and which seems to be derived from very ancient traditions, foreign to Christian Gallo-Roman antiquity. A century later this custom of enclosing the body in a sarcophagus perched on little columns, as we have stated





above, was entirely abandoned in the northern provinces, and very rarely practised even in those of the South. Bodies were interred. Yet tradition influenced the visible forms of the tombs. One still sees in the cloister of the church of S. Salvy (of Alby) a tomb dating from the second half of the 13<sup>th</sup> century, that presents an arrangement analogous to that of the monument of the Chartreuse of Toulouse given above. At S. Salvy the arcade did not protect the sarcophagus, but indeed the solid wall built over the grave and forming a substructure. Here (Fig. 5) is the plan of the tomb of S. Salvy and its elevation (Fig. 6). The recess beneath which is placed the sarcophagus is divided by a pier against which is placed a statue.<sup>1</sup> Two little cross vaults cover that recess 3.2 ft. deep. Above the arches are placed three statues; the Virgin and two kneeling figures, a man and woman, who can only be the persons for whom the tomb was built. These three statues are sheltered beneath a triple arcade crowned by a very obtuse gable. Traces of paintings are still found, that entirely covered the architecture and statuary. Angels fill the two tympanums of the lower niche over the sarcophagus, and we do not think that the man and woman in adoration at both sides of the Virgin were represented on the slab covering their tomb. The engaged pier A (see plan) forms a cross detached on the two tympanums (see detail B, Fig. 6). A little holy water stoup is engaged in the wall at the right side.

Note 1.p.29. This mutilated statue is that of S. Paul, probably patron saint of the deceased.

At the sides of collegiate and parish churches habitually existed cloisters, and these cloisters served as burial places, not only for clerics, but also for laymen that paid very dear for that advantage of being interred near the church.<sup>1</sup> The preferred location was always the wall of the church itself. Thus beside our religious monuments between the buttresses that extended into a portico of the cloister, are still found numerous traces of those interments.

Note 1.p.31. Old French poem. *Complainte* of Francois Garin. 15<sup>th</sup> century. Edition of 1832. Cropelet. p. 32.

In the 13<sup>th</sup> century the ecclesiastical laws forbidding interment of the laity within the walls themselves of the church fell into disuse. The chapters of the cathedrals alone generally





continued to observe these rules, but the parish, collegiate and abbey and abbey churches even derived a considerable profit from the sale of the right of interment in the churches, and soon the walls and pavements of the naves were covered by monuments, inscriptions and effigies. Choirs were reserved for members of the clergy or very high personages. Even in the cathedrals, bishops were buried under the pavement of the choir or between the piers of the sanctuary, and exceptionally princes enjoyed the same privilege. In excavating the choir of Notre Dame of Paris to establish there the present crypt of the archbishops, we found the tomb of Isabelle of Hainault, first wife of Philip August, who must have been interred beneath that pavement, when the church was scarcely erected to the vaults.<sup>2</sup>

Note 2.p.31. The silver seal of that princess was deposited in the coffin. Preserved for several years in the treasury of the cathedral, it has been stolen.

Principally in the abbey church were buried princes. The founders of abbeys reserved the right of interment of themselves and their successors in the church erected with their gifts. Thus many remarkable monuments were preserved until the end of the last (18th) century, and even till our days. The abbeys of S. Denis in France, S. Genevieve, S. Germain-des-Prés, at Paris, Braisne, Vendome, Jumieges, Fecamp, Longpont, Royaumont, Ecu, of Celestins at Paris, of Poissy, contained splendid tombs of princes and lords, and some of those monuments have remained to us. The abbey of S. Denis, founded by Dagobert, was particularly destined for the interment of French kings, and in fact received the remains of most of those princes from the founder until Louis XV. The church having been rebuilt by Suger, it is to be believed that the old monuments (so far as mausoleums had been built over the tombs of the princes) were destroyed or greatly damaged. When later about the middle of the 13th century the greater part of the constructions of the 12th century was replaced, when there were built the nave, the transepts and the entire high choir, the last remains of tombs preceding Louis IX were dispersed, so much so that to not lose the memory of those venerable tombs, S. Louis resolved to reestablish all those tombs, commencing with that of Dagobert. The bones that could be found in the old coffins were replaced in the new tombs. Among the tombs preceding S. Louis, a single one was





reserved and replaced in the middle of the choir of the religious; it was that of Charles the Bald, which was of bronze with enameled parts, and which probably owed to the solidity of the metal, that it was not destroyed like the others. From the tomb of Dagobert remained under the cloister of the church of Suger a fragment mentioned by Dom. Doublet,<sup>1</sup> and that M. Percier drew in 1797. This was a colored statue, seated and crowned, clothed in a long tunic and a pallium. We reproduce here (Fig. 7) the fragment preserved by the drawing of Percier, and which causes one to believe, that this monument was not earlier than the beginning of the 12<sup>th</sup> century. However that was, we have been unable to find a trace of this figure, no more than of those of the two princes Clovis and Sigebert, that formed a part of the same monument. S. Louis no less erected a new tomb to the founder of the abbey, and placed it at the entrance of the sanctuary on the epistli side.<sup>2</sup> That tomb consequently dates from the middle of the 13<sup>th</sup> century, and is one of the most curious funerary monuments of that epoch. It consists (Sfig. 8) of a great niche surmounted by a gable; at the bottom of the niche is placed a sanctuary,<sup>3</sup> whose cover serves as a bed for the statue of the king lying on the left side. At the back of the niche is developed on superposed bands the legend relating to the death of Dagobert.

Note 1.p.32. "At the entrance of the said doorway," (that of the transept looking south, in the cloister of the religious), "entering these cloisters, on the right hand is seen the effigy of the very Christian king Dagobert, of unusual size and seated in a chair, the crown on his head and a ball in his right hand; having at its two sides the effigies of his two sons Clovis and Sigebert, in lias stone." Dom. Doublet, *Antiq. et rech. de l'abbaye de S. denis en France*. Book I. Chap. 44.

Note 2.p.32. This tomb is now replaced on the same spot, after having been transferred to the museum of French monuments, then restored to the church, where the two fronts are separated to form opposites, and are placed at both sides of the northex.

Note 3.p.32. This sarcophagus was feigned, for the corpse of king Dagobert had been deposited under the high altar of the primitive church; perhaps it was enclosed in the coffin, whose lid and end we have given, decorated by pottee crosses. (Fig. 1, A). Yet the stone replaced in the reign of S. Louis had been hollowed





as if to deposit a body there, and remains of bones were found there at the violation of the tombs in 1793.

Standing at the sides of the royal effigy are the statues of Nantilde, second wife of Dagobert, and of Sigebert, his eldest son, who were buried near him. On the arches covering the niche are sculptured angels bearing censers, and in the tympanum of the gable, Christ and two bishops, S. Denis and S. Martin, in company with S. Maurice, who delivered the soul of the king from the hands of demons, and led him into Paradise. The front of the sarcophagus is covered by fleurs-de-lis, as well as the base.<sup>1</sup> The entire monument was painted; besides the still visible traces of those paintings, the sketches of Percier furnish all the details of the coloring. This tomb not being colossal, allows its rear part to be seen in the side aisle. That is also surmounted by a gable with figures, crockets and cross-flowers, the lower part remaining plain without coloring.

Note 1.p.33. This sarcophagus must have been rebuilt as well as the reclining statue and that of Sigebert, which were lost in the successive transfers that this monument suffered. Further the sarcophagus and the two statues were copied as faithfully as possible from the drawings that Percier made of this tomb before its transfer to the museum of Petits-Augustins. The primitive sarcophagus, according to the statement of Dom. Doublet, was of grey porphyry, but the fragments that we have had in our hands were of soft grayish sandstone.

Certain parts of the statuary of the tomb of Dagobert are very remarkably treated. The statue of Nantilde, to which at the museum of Petits-Augustins M. Lenoir had fitted the head of a man,<sup>1</sup> the groups of bishops in the bands of legends, the angels of the arches, the sculpture of the tympanum below the gable, are in excellent style and perfect execution. This tomb is not in the style of one of those shrines placed in the interior of churches; it is a chapel, one of the little structures erected in cloisters between the buttresses of churches, and that is why we have presented it here; yet the effigy of the deceased is sculptured on the true or false sarcophagus, while neither the tomb of Toulouse nor that of S. Salvy of Alby had reclining statues.

Note 1.p.35. It must be noted that this statue, so ridiculously disfigured, has been cast, reduced and sold everywhere as





one of the remarkable works of the middle ages.

Here again is one of those monuments in the form of a niche without effigies; it is that of the two prelates Baldwin II and Baldwin III, bishops of Noyon, who were placed against the wall of the abbey church of Ourscamp at the gospel side (Fig. 9).<sup>2</sup>

Baldwin II died in 1167. The epitaphs were painted on the walls of the niche, and had been replaced a century before Gaigneres, from whom we borrow this drawing, by inscriptions on vellum placed in frames attached by little chains. Here at St. Salvy the little pier forming the arcade rests on the sarcophagus and protects its lid. This tomb presents no funereal attributes, no more than those of St. Salvy or of Dagobert. Flowers, foliage, legendary subjects, where personages nowise assume the attitudes of sorrow, ornament these shrines and make them works of art agreeable to see, where nothing causes a thought of material decomposition, of eternal night. On the tombs on the contrary, the artists of the middle ages affect to scatter flowers and leaves in profusion, just as done around the body at the moment of interment.<sup>3</sup> Animals, hunts, processions of personages, on those monuments recall life and not death. When the effigies of the dead are sculptured as reclining on the sarcophagus, they assume the attitude of death only very late. Habitually these figures during the 12<sup>th</sup> and 13<sup>th</sup> centuries have their eyes open, the pose and attitudes of living persons. About the middle of the 14<sup>th</sup> century the statuaries sometimes give them the appearance of slumber, but without any signs of death. These personages are further clothed and armed, if warriors, covered by religious vestments, if clerics.

Note 2.p.35. This tomb dates from the first years of the 13<sup>th</sup> century.

Note 3.p.35. We have very frequently found under the remains of persons buried during the 12<sup>th</sup>, 13<sup>th</sup> and 14<sup>th</sup> centuries still visible layers of plants and flowers, notably of roses easily recognizable by their branches with thorns. Was it not more sensible to bear this regretted person to his last abode, than to place his body in those black and white hearse of such ridiculous forms, decorated in the worst taste, driven by coachmen dressed in burlesque fashion?

Before speaking of tombs forming isolated structures, it is also necessary for us to cite some of these monuments in the





form of niches or chapels, but with effigies of the dead placed on the sarcophagus. In the side aisle of the choir of the cathedral of Rouen exists one of these tombs belonging to a bishop, which dates from the end of the 12 th century, and which is of very beautiful work. This monument otherwise presents no remarkable peculiarities. The statue of the prelate rests beneath a niche surmounted by a low gable. As always, this tomb was painted.

Here is another (Fig. 10), <sup>1</sup> which was placed at Fontevrault against the wall of the side aisle at the right of the main altar (gospel side). It was that of bishop Pierre of Poitiers (13 th century). The statue lies on a draped bed and is surrounded by little figures in the round representing the religious present at the funeral of the bishop. Among these religious are distinguished the abbess of Fontevrault and an abbot, both holding the crozier, the mark of their dignity. The other persons carry crosses and candles. The chasuble of the bishop was of greenish blue with crosslets of gold repeated in red; his white mitre with a red band, the alb white, stole green, and the shoes black. The abbess was clothed in black, and of the religious, some were in white and others in green, detached on a red ground. An arch covered the sarcophagus, but it was already destroyed in the time of Gaignieres, who left us the drawing of this curious monument.

Note 1.p.37. Collection Gaignieres. Bodleian Library of Oxford.

One still sees in the cathedral of Limoges against the north aisle one of those tombs in the form of niches or chapels, dating from the 14 th century; it is that of a bishop Bernard Brun. This monument is engraved in the work of M. Gailhabaud. <sup>1</sup> At the back of the niche and separated by a middle pier, reliefs represent subjects from the legend of S. Valeria, a crucifixion, a coronation of the Virgin and a last judgment. It is also necessary to cite two pretty tombs belonging to the same epoch, and that are placed against the wall of the chapel of the Virgin in the cathedral of Amiens. They are in the form of a niche covered by a low arch surmounted by a gable. On the base bearing the reclining statues of the dead, are sculptured in little niches religious persons, canons and laymen, who compose the procession accompanying the bodies to their last habitation. The shields of arms of two personages, a bishop and a canon, are painted at the back of the niches.





Note 1.p.38. L'architecture et les arts, quite dependent.

One of the most interesting funerary monuments, taking the form of a niche with figures, is that of the tomb of the priest Bartholomew, placed in the church of Chenerailles, of which he was probably the founder. This tomb is engaged in the third bay of the south side, is placed 6.6 ft. above the pavement, and is cut from one block of limestone. Its architecture presents a pointed arch with two buttresses. The recess is divided in zones, in each of which are detached persons in the round. The lower zone represents the scene of the interment of the dead. The Holy Virgin occupies in the middle zone the summit of a little shrine with stairs. S. Martial climbs the stairs with a censer in his hand. On the ground at the right of the Virgin is represented the martyrdom of S. Cyr and of his mother S. J Julite. At his left the priest Bartholomew, kneeling, is presented to the infant Jesus by his patron and S. Aignan, bishop. Beneath the arch is sculptured a crucifixion. On two scrolls placed under the first and second zones are read a Latin inscription.

Note 2.p.38. See in *Annales archæologiques*, Didron, the Notice of Abbe Texier on this monument, and the engraving of M. Gachereul. Vol. IX. p. 193.

The sculpture of this little monument is in mediocre style, but its composition is happy.

Here (Fig. 11) is another example of those engaged tombs in the form of a niche with an effigy of the dead. This example dates from about 1300. The name of the deceased is not preserved. This tomb was later inserted in the wall of the north side aisle of the church of S. Pere (S. Pierre) sous Vezelay. The back of the recess is occupied by a relief on a good style. At the centre the seated Christ receives from S. Pierre kneeling a broken object that he holds in his left hand. On the other side the Holy Virgin seems to intercede with her divine Son. Two angels bearing censers terminate the scene. Evidently the Virgin of S. Pierre causes to avail with the supreme judge the merits of the dead, who might be one of the founders of parts of this church rebuilt about the end of the 13 th century. Was the object held by S. Peter the model of the restored church? that seems possible. This monument is also much mutilated, and the statue of the person in civil clothing is completely defaced.





The sculpture and architecture were painted and gilded. The inscription was also painted and was placed below the relief; some of its letters are scarcely seen underneath the whitewash.

As easily recognized, the principle of this tomb is the same as that adopted for the beautiful monument of S. Denis erected to Dagobert. We do not think it necessary to emphasize further this kind of tombs in the form of niches or chapels against the wall, and we shall pass to the examination of isolated tombs, commencing with the simplest and that are the oldest.

On the summits of the Vosges near Saverne are found the remains of enclosures and of ruins dating from a remote epoch, and particularly between Saverne and Dabo, numerous cemeteries have been discovered. Most of the tombs that they contain present a singular arrangement. These funerary monuments consist of a trough or a simple hole in the ground enclosed by dry stones, containing a vase for ashes; the whole is covered by a stone in the form of a slightly convex triangular prism. At the base of a front face is pierced a hole in the shape of a little arch, corresponding to the hole made in the block.

Note 1.p.40. See the interesting Notice of Col. de Morlet on this monument. Strösbürg. 1863.

Fig. 12 shows one of these monuments in section (A), with the separate cover at B. Sometimes, but more rarely, these covers are not curved (Fig. 13). The Gaulish circle, imbrications or ornaments in the Gallo-Roman style ornament them. Col. Morlet, who brought to light these discoveries, in fact considers with reason, that these tombs are later than the conquest of Gaul by the Romans; the objects, medals and vases found about them and the inscriptions engraved on their surfaces can leave no doubt in that respect.

"The funeral monuments concealed on the summits of the Vosges between Saverne and Dabo were not scattered at hazard on those high plateaus, says Col. Morlet in conclusion, but collected in actual cemeteries surrounded by temples, altars and houses; they announce the permanent presence of a numerous population, charged with defending the great fortified camps, whose traces are visible."

"Favored by the shape of the ground descending in a gentle slope toward Lorraine, while it stops abruptly in a peak on the side of Alsace, these positions must have been occupied and





fortified from the highest antiquity, to arrest invasions from beyond the Rhine. Much before the Romans there were indeed bloody combats on that natural barrier, where every Cymric, Celtic or Germanic invasion, saw arise networks of defense, upon which the Gallo-Roman epoch left a last impression."

"Thus doubtless the tombs described above are found mixed with the remains of a more ancient epoch, like the great double walls of Gros-Limmersburg, where I cannot recognize Roman art."

"The coin of Titus found at Kempel, as well as the good fabrication of the vase discovered at the same place, announce that these necropolises existed from the earliest times of the Christian era."

"These tombs have nothing Germanic; they are Gaulish of the Roman era. Their special character consists in the little opening that they have at their bases, and in the pointed arch that generally terminates their tops."

"The opening of the base is difficult to explain without admitting that this may be a means of communicating with the ashes of the dead and of making libations."

"The pointed arch, whose exact image is found in the funereal monuments of Asia Minor, might it not be the indication of a tradition preceding the Celtic invasion, that was preserved by a tribe camped on the summit of the Vosges?"

In fact, Lycian tombs in great number terminate at their tops by a sort of lid or cover imitated from a wooden structure, and assumes the form of a curvilinear prism,<sup>1</sup> and penetrating into the extreme Orient, one finds Hindoo tombs presenting the same geometrical appearance. Without attaching more importance to these relations than is proper, it is necessary to take them into account, for we see that form for covering the body persist among the peoples that come from the northern Orient.

Note 1.p.42. Among others, see the beautiful examples of those tombs deposited in the British museum.

The Salic law mentions the construction, balustrade, little edifice or little bridge, placed over the dead man.<sup>2</sup> Gregory of Tours,<sup>3</sup> concerning a theft with breaking committed in the basilica of S. Martin of Tours, says that the thieves entered by a window by climbing a grating that they had removed from the tomb of a dead man (Latin text). The Anglo-Saxons had a custom of placing on the tomb of the dead a sort of cradle of wood





or iron (bier), that was covered by a pall.<sup>4</sup> Now the form of the Lycian tombs, and that of the tombs of the Vosges, indicate the "aristato"<sup>5</sup> cited by the Salic law, the bier of the Anglo-Saxons, the catafalques represented in the embroideries of Bayeux (called the tapestry of queen Matilda); and although the stones of the Vosges cover the cinerary urns, and that neither the Franks nor the English burned their corpses, it is difficult not to admit a similar origin for that form of tomb, representing a pall covering a frame of wood or iron. Observe that this aristato or bier covered, not the dead but the sepulchre of the dead; it is what we call today a catafalque. It is not the bier, but the honorable and visible sign that indicates the place of the tomb.

Note 2.p.42. No. 5 of the text states:—"If some one has destroyed the little edifice, which is the little bridge," let it be done to him according to the custom of our fathers.

Note 3.p.42. Book VI. Chap. 10.

Note 4.p.42. See the work of Dr. Roques- The Church of our fathers, and the Notice of M. Feytaud, *Annales Archéologiques*. Vol. XV. p. 38. -- See the monument of Beauchamp.

Note 5.p.42. See Ducange, Gloss.

The Lycian tomb deposited in the British Museum presents that curious peculiarity (Fig. 14), that the sarcophagus A, properly so-called, which is of marble, and in which were deposited the remains of the dead, assumes the shape proper for that material, while the part P C is a covering, although likewise cut in blocks of marble, but takes the appearance of a wooden structure. the curvilinear top C is even covered by a pall imitating a fabric with embroidery in very low relief, and the metal ornaments that this pall can receive by the projecting muzzles of lions. In this tomb, there is then the tomb proper and the catafalque over it. Same arrangement on a small scale in the tombs of the Vosges, for the tombs mentioned by Gregory of Tours; and for the monument of Beauchamp, where the effigy of the dead is placed on the sarcophagus and covered by an iron bier on which was placed the pall. Same arrangement adopted for the tomb of the religious William, formerly placed near the door of the chapter in the cloister of the abbey of Noaille (Fig. 15), and which dates from the end of the 12th century.<sup>1</sup> This stone is nothing but the catafalque, the representation of the aristato, of the





pall placed on a frame and covering the place where reposes the dead.

Note 1.p.43. See the portfolios of *Épigraphes*, Rodolphe Libby.

But here is an interesting example, that presents itself and gives greater value to the preceding observations. The little church of S. Dizier in Alsace contains several tombs, among others that attributed to S. Dizier, bishop says the legend. This tomb further does not date beyond the middle of the 12<sup>th</sup> century, and is nothing but a stone hollowed in the form of a little cell with two doorways (Fig. 16). The cell is monolithic and is terminated in its upper part by two slopes covered by rich ornaments. "Until in 1335," says M. Anatole de Barthelémy, from whom we borrow this detail, <sup>1</sup>"they caused to pass through these openings persons attacked by mental alienation." Here is the aristato or pall, the antique catafalque covering the body of the saint, and possessed of miraculous properties. The body is buried and its place is consecrated by this shrine, that always reproduces the arrangement found in Lycia, on the summits of the Vosges, at the abbey of Noaille, and that we shall see developed with the art of the 13<sup>th</sup> century at its climax.

Note 1.p.44. *Annales archéologiques*. Vol. XVIII. p. 49.

Let us cite the charming tomb of S. Etienne, placed in the church of Obazine. The reclining effigy of the saint is protected from contact by an open arcade; above the arcade is a rich pall forming a roof with two slopes and covered by reliefs. Monks leave their coffins and come to prostrate themselves before the Virgin. Angels holding torches appear at half length between the gables sculptured on the slopes and terminated by foliage cresting. <sup>1</sup> But we see how is perpetuated this memorial of the antique tomb. In the cemetery that still surrounds the church of Montreal, one notes several tombs of this form (Fig. 17). This stone in form of a crossed roof on the walls covers the grave. Sketch A gives the detail of the three gables of the rear end of the cross arm. As for the gable B of the front end, it has a little niche with cup forming a holy water stoup. Does not one find there a last trace of antique traditions Christianized? But this arrangement must furnish architectural motives rich otherwise. Only persons of small importance were interred in the cemeteries, while after the 13<sup>th</sup> century the churches were reserved for the burial of the great. Besides the tombs





placed against the walls in the form of niches, and flat tombs of which we shall soon speak, there were erected a very great number of tombs with forms approaching the catafalque tomb. The effigy of the dead was placed on a sort of open bench set over the grave. A canopy supported by little piers formed an enclosure taking the place of the pall, of the aristato previously mentioned. It does not seem that in the provinces of the North of France (unless during the Merovingian and Carlovingian epochs), an arrangement consisting of a sarcophagus actually receiving the body, erected on feet and surmounted by a small structure in the form of a canopy. The tomb of king William I, deposited in the basilica of Montreale at Salerno, was so conceived. It consists of a tub of porphyry raised on two perforated feet. A roof resting on 6 porphyry columns protects the tub. Then in France (in the 12 th century) the body was placed in the earth in a coffin of stone, wood or metal, and as we have already stated, the visible monument was only an imitation, an indication of the place where the body reposed. It is very important to not lose sight of this principle, which influenced the composition of all French funerary monuments at least from the 12 th century.

When S. Louis caused the restoration of most of the tombs of his predecessors in the abbey church of S. Denis, the artist charged with this work adopted a mixed method. Not wishing to encumber the transept, in the midst of which were placed these tombs, having to economize space and perhaps not having sufficient resources, he could not erect a canopy over each tomb. The kings and queens in pairs were placed on bases, behind their heads was erected a double canopy in the form of a back, with two little columns accompanying and surmounting those canopies permitting the placing of torches on their capitals and between their shafts. Perhaps on certain days, cloth palls attached to these little columns were hung on each tomb. Here is the occasion for speaking of the illumination of tombs, a custom extending back to a very remote antiquity. The Greeks lighted funereal monuments, and most tombs existing in such great number in central Syria are surmounted by pyramids arranged for placing lamps on little corbels for that purpose placed on the inclined planes.<sup>1</sup> After the establishment of Christianity in Gaul, the cemeteries were illuminated on the occasion of certain festivals, and a





beacon was lighted at night within their enclosure. Some tombs of the middle ages still have iron candlesticks intended to be bear tapers and the tombs erected by Louis IX at S. Denis adopt that method.

Note 1.p.48. See *Syrie centrale*, the work by count Melchior de Voëue.

Fig. 18 represents one of those double tombs.<sup>2</sup> This arrangement is very original, but does not appear to be an exception, for one frequently notes on the sides of the bases receiving the effigies of the dead, traces of support of stone, metal or even of wood, bearing those candlesticks for tapers and perhaps palls of cloth. The tombs with fixed canopies of stone or wood are only a derivative from the same principle. Many of these were formerly seen in our abbey churches at Royaumont, the abbeys of S. Denis, Longpont, Eu, Braisne, S. Seine and Poissy; at the Jacobins and Celestins of Paris. Some cathedrals likewise possessed them, Amiens, Rouen, and Sens. They are still seen around the choirs of those of Limoges and of Narbonne.

Note 2.p.47. All the effigies of these tombs are old, replaced recently in the transepts, where they were before 1793. The bases, blocks and little columns, were restored after the drawings of Goussier and from fragments deposited in the storerooms of the abbey.

Here among others is the tomb of Charles, count of Etampes, grandson of Philip the Bold, that was placed behind the great altar in the church of Cordeliers at Paris.<sup>1</sup> This count of Etampes died in 1336 (Fig. 19). The statue in white marble rests on a slab of black marble with plinth ornamented by arcades of white marble on a black ground. A canopy of charming work protects the head; the epitaph is engraved behind the canopy. The open structure of stone was entirely painted and gilded, and the plan presents a curious arrangement. Established between two great piers behind the choir, this plan is so drawn as to escape those piers and to leave the architecture of the canopy free (Fig. 20).<sup>1</sup> The vaults were painted blue with gold fleure-de-lis, and the little buttresses were overlain by panels of glass painted underneath, like those seen in certain parts of the S. chapelle of Paris.

Note 1.p.49. The white marble effigy still exists at S. Denis. This is a statue of admirable work.





Note 1.p.50. See the portfolios of Gaignières, Bodleian library of Oxford.

Sometimes the base supporting the statue was perforated; such was the tomb of a lord of Coucy placed between two piers at the left of the great altar of the abbey of Longpont, and that dates from the end of the 13<sup>th</sup> century.<sup>2</sup> Like the preceding, this tomb was entirely painted. The warrior's costume of the personage belongs to the last years of the 13<sup>th</sup> century.

Note 2.p.50. This tomb no longer exists, but it is reproduced by Gaignières, and although he does not give the epitaph, the arms (fessy of vair and gules) leave no doubt of the rank of the personage.

To maintain the integrity of a principle and to deduce therefrom very different consequences, is the result of an art that has found its path. The programme of the catafalque monument was adopted after the 13<sup>th</sup> century for the interment of important personages, by preference to the tomb in form of a niche; yet what a variety in not only the details of this little structure, but also in the mode of interpreting the programme! For example, here (Fig. 21) is also one of the funerary monuments of the abbey of Longpont, that was placed at the left of the great altar. It is that of a woman. The effigy of the dead is no longer placed on the credence covering the place of interment, but beneath that perforated credence, while a richly decorated crucifix is laid on the credence. A structure nearly similar to the preceding covers this image.<sup>1</sup> This tomb dates from the middle of the 14<sup>th</sup> century. We also cite among the most remarkable catafalque tombs of this epoch that of archbishop Pierre de la Jugée, placed between two piers of the choir of the cathedral of Narbonne (southern side). Why were the statue and one of the charming reliefs of this tomb removed to be deposited in the museum of Toulouse? We cannot say. Why does not the cathedral of Narbonne reclaim those fragments, so as to restore them? That can be explained only by a profound indifference for those precious remains, become so rare in our old churches, and yet left to neglect or even daily deterioration, when the authorities do not remove them to place some new decoration in equivocal taste. This tomb of the cathedral of Narbonne, although mutilated in the most barbarous manner, is still a real jewel, retaining its paintings in charming taste and





statuettes in excellent style.

Note 1.p.51. See the collection of Galignières, Bodleian Library of Oxford.

We give its plan (Fig. 22). The choir being 3.3 ft. above the side aisle, on that side a lower row of reliefs compensates for the difference in level. Fig. 23 gives the section of the monument with an indication of the paintings found above the head of the prelate. Two angels carry his soul to heaven. Beneath the side arch, quatrefoils with the arms of the deceased alternate with the birds facing each other. The vaults are painted blue, and all the mouldings are in varied tints with very happy harmony.

Fig. 24 gives the front of the tomb next the side aisle. The two reliefs in hard alabaster represent, the upper one bishops in niches with gables, the lower one canons in pairs present at the obsequies. This tomb, as well as some others still existing in the cathedral of Narbonne, forms an enclosure of the choir. The same arrangement exists at Limoges, and existed at Amiens before the establishment of the ridiculous decorations in plaster, that dishonor the choir of the cathedral, and that are due to one of its bishops of the last (18 th) century. 1

Note 1.p.52. Among these ornaments in deplorable taste, that replaced precious monuments, whose character if not their value as art should at least have made them respected, it is necessary to mention a certain glory of gilded wood, that casts its rays of carpentry and its clouds of plaster on the piers of the apse up to the height of the gallery, thus destroying the marvellous effect of this apse with its apsidal chapel.

Among the tombs of the cathedral of Limoges we cite that placed between the piers on the south side of the choir. This tomb of a bishop presents one of those original arrangements, that the artists of the middle ages always knew how to invent. A perspective drawing (Fig. 25) will show the effect from the side aisle. Two censer bearers open a curtain, that allows the recumbent statue of the prelate to be seen. The vault of the little structure is a tunnel vault, and reliefs decorate its piers. Before the base two canons are sculptured in little niches. This monument likewise dates from the 14 th century. This arrangement was retained until the epoch of the Renaissance, and we possess a great number of representations of tombs with more





or less rich canopies, protecting the effigy of the dead. One again finds the application of this principle in the celebrated tombs of Louis XII, Francis I and Henry II, erected at S. Denis. Yet the programme of the 13<sup>th</sup> and 14<sup>th</sup> centuries is modified in one capital point. In these last monuments, the personages are represented in the appearance of death beneath the cenotaph; clothed, alive and kneeling above it. The monument covering the tomb of Francis I shows not only nude figures of the king and of queen Claude beneath the cenotaph, but also on the top are the same figures kneeling, clothed and accompanied by the dauphin Francis, prince Charles of Orleans and Charlotte of France, who died at the age of eight years. Let us state in passing, that this tomb, attributed by some to Italian artists, is due to Philibert de l'Orme as architect; to Pierre Bontemps, master sculptor, citizen of Paris, who by the contract for 1699 1 livres dated Oct. 6, 1552, engaged to execute a part of the celebrated reliefs of the stylobate representing the coronation; to Germain Pilon, who executed for 1100 livres the eight figures of Fortune (below the vault of the cenotaph); to Ambroise P Perret, who made the four evangelists; and finally for the ornamentation, to Jacques Chantrel, pastille Galle, Pierre Bigoigne and Jean Bourgy. The beautiful recumbent figures belong to the French school, and appear to have left the studio of Jean Goulon. As for the statuary of the tomb of Henry II, it is entirely by the hand of Germain Pilon. <sup>1</sup>

Note 1. p. 58. For more ample details of those tombs, see *Monographie de l'église royale de S. Denis*, by Baron de Guilhermy. 1848.

From the end of the 15<sup>th</sup> century, many funerary monuments adopt this arrangement of a representation of the deceased beneath the cenotaph, and of the same person living and kneeling on its covering; then they come sometimes to suppress the effigy of the corpse, only showing the figures of the personages kneeling on a base or on the imitation of a sarcophagus. Yet so far as we know, those compositions do not appear in full before the second half of the 15<sup>th</sup> century.

In the 16<sup>th</sup> century, they become quite common. The tomb of Charles VIII at S. Denis presents this arrangement.

Charles VIII died April 7, 1498, and consequently his tomb already belongs to the style called the French Renaissance.



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It was very beautiful,<sup>2</sup> and has been engraved several times. Gaignieres gave a good drawing of it in his collection. As a corollary of these cenotaph tombs, it is necessary to cite the monuments attached to the walls, which present on a vertical surface all parts constituting a mausoleum with substructure, image of the dead and a canopy.

Note 2.p.56. See what Dom. Doublet says of it; (*Hist. de l'abbey de S. Denys en France*, 1635. Book IV. p. 1293):- "His effigiey (of the king Charles VIII) clothed in royal robes, and on his knees over the tomb, is represented from nature in cast iron; the top of the said tomb is covered by gilded copper, on which is placed a crown with an open book, likewise of gilded copper. Also at the four corners are four angels of cast iron well gilded and wrought, that hold the shields of arms of the kingdoms of Naples and of Sicily, also of cast iron, gilded and pointed. At the sides of the tomb are round niches, and within are basins of copper well gilded, and in these basins are low figures of cast iron, well gilded."

D. Millet in his *Tresor sacre de l'abbaye royale de S. Denys en France*, 1640, says:- "His sepulchre (of the king Charles VIII) is the most beautiful in the choir, on which one sees his effigiey represented of natural size and kneeling, a crown and book on an oratory (bench), and four angels on their knees at the four corners of the tomb, all of gilded copper, except the effigiey, whose robe is blue, sprinkled with fleurs-de-lis of gold."

Note 1.p.57. From Bodleian Library. See the engraving of the work of Felibien. *Abbey royale de S. Denis*.

These sorts of monuments are now very rare in France; the lack of space and also the want of money sometimes cause the adoption of this method. We know two beautiful examples of them in the old cathedral of Carcassonne. One dates from the middle of the 13th century, that of bishop Radulphe. The image of the sarcophagus, which persists late in the southern provinces of France, is placed on three little columns and seems engaged in the wall. Canons under an arcade are present at the obsequies. Standing on the sarcophagus in relief is the figure of the bishop blessing. A gable decorated by cross-flowers and crockets crowns the whole. The other tomb (Fig. 26) dates from the beginning of the 14th century; it is that of bishop Pierre de





Roquefort, who caused the choir of the church to be rebuilt, with two chapels adjoining the transepts.<sup>2</sup> This monument, as our drawing shows, presents in the flat, let us say, the arrangement of cenotaph tombs; the bishop does not lie on the base, which is only a facing, but stands on it; he is covered by a slab canopy; a canon and a deacon accompany the principal figure in two lateral arches. As we said, this arrangement is rare in France, and we know of no example still existing in the provinces of the North.

Note 2.p.57. Art. gothédrale, pl. 49. The tomb of Pierre de Roquefort is placed against the western wall of the north chapel. This prelate died in 1321.

It remains to us to speak of horizontal tombs with effigies in relief or simply engraved on stone or metal. These tombs are of two kinds: either the effigies of the dead are placed on a very low base, presenting a slight projection above the floor, or they are flush with it, so as to permit one to walk on it as on a pavement. We do not doubt that the first of these tombs were covered by cloth hangings on anniversaries or on certain solemn days, and we give as proof thereof the metal fastenings or the pins, whose traces are frequently found along the bases. For the second, they were only a visible sign indicating the place of interment.

There exist horizontal tombs of a quite early epoch, i.e., dating back to the 12th century, but while presenting little relief, they project sufficiently over the ground that one cannot walk on them, while only about 1225 men commence to see horizontal tombs on the level of the ground and only engraved.

However it is necessary to mention here a very singular tomb, formerly placed in the choir of the church S. Germain-des-Prés at Paris, and that is now deposited at S. Denis; it is that of Fredegonde. Dom. Bouillard<sup>1</sup> claims that this princess was interred in the basilica of Ss. Croix and Vincent, at the north side near the great wall supporting the tower. The existing tomb does not date back to the first half of the 12th century. It is a facing of lias stone overlaid with fragments of glass pastes and hard stone, mingled with strips of copper. Recesses left in the stone form the outlines of the clothing. The head, hands and feet are entirely plain today, but very probably were painted. We know no other example of this kind of funerary mon-





monument; <sup>2</sup> it is difficult to discover the motives causing the religious of S. Germain-des-Pres to execute this monument by a procedure so little used. Was it to imitate a much older mosaic made as cloisonnée after the indications of Byzantine artists? Was it the attempt of a western artist? We cannot say. Other horizontal tombs in mosaic exist, among others being that of Frumaldus, bishop of Arras, dying in 1130, <sup>3</sup> and that found in the ruins of the abbey of S. Bertin, with the date of 1109; but these tombs are executed according to the ordinary procedure of the mosaicist employed in Italy and France in the 12<sup>th</sup> century, a procedure nowise resembling that adopted for the effigy of Predegonde.

Note 1.p.59. Hist. de l'abb. roy. de S. Germain-des-Pres. Po Paris. 1724.

Note 2.p.59. This tomb has been reproduced frequently by engraving and chromolithography; (see Statistique de Paris, by M. Alb. Lenoir; the work of M. Gailhabaud, l'architecture etc.; D. Bouillord, Hist. de l'abb. de S. Germain-des-Pres; Alex Lenoir, Musée des monuments français; de Guilhermy, Monographie de l'église royale de S. Denis).

Note 3.p.59. See the work cited by M. Gailhabaud.

There remain to us two beautiful tombs dating from the 12<sup>th</sup> century, that represent in flat relief the effigies of the kings Clovis I and Childebert I. These tombs come from the abbey of S. Germain-des-Pres, and are now deposited at S. Denis. The relief of these figures is obtained by a deep cavity left in a thick slab of stone. They had replaced in the church S. Germain-des-Pres much older monuments, but much injured when the abbey was taken by the Normans.

At the end of the 12<sup>th</sup> and beginning of the 13<sup>th</sup> centuries, were placed in the churches many of these tombs with effigies in low relief. They were very frequently executed in cast or hammered bronze, enameled, and consisted of a plate of metal set with the four corners on very stumpy little columns, on lions or simply on blocks. The tomb of Charles the Bald, placed in the middle of the choir of the religious of S. Denis, was so composed, and its fabrication appears to belong to the first years of the 13<sup>th</sup> century. We give a copy of it (Fig. 27) from the drawing in the collection of Gaignières. The emperor is represented in high relief; his head rests on a cushion, his feet





on a lion. The right hand holds the sceptre with the fleur-de-lis, the left a sphere. He is clothed in three robes, the two lower ones open at the side, and the round mantle fastened on the right shoulder; he wears the crown with cross-flowers. Two little angels are placed in the angles of the trefoil that encloses the head of the prince and hold censers and incense-boxes. At the four angles A of the plate are seated four statues of bishops. An incised inscription forms a border of the tomb. The ground of the slab is entirely enameled blue with fleurs-de-lis and network of gold. Overlaid plates of enamel also decorate the borders of the robe and mantle. Four lions of bronze rest on very short twin columns of stone, and support this slab, (See elevation, fig. 27 bis), leaving a space of about 1.8 ft. beneath it.<sup>1</sup>

Note 1.p.60. This monument was sent to the foundry in 1793.

We no longer possess in France more than four tombs of metal in the style of that of Charles the Bald. Two are without enamels, and are tombs of bishops of Amiens, Ewrad de Fouilloy and Godofroy; one of these monuments is of great value as art, that of bishop Ewrad. The head and draperies are admirably modeled and in an excellent style.

We give (Fig.28) a copy of this tomb. The personage in half round is cast with the plate, and this rests on a very low plinth of stone with six issuing lions. The bishop blesses and bears the crozier. Two angels in low relief have censers and cense his head, which rests on a richly decorated cushion. Two clerics are also in low relief and hold torches. The feet of the prelate rest on two dragons. An inscription and a beautiful running ornament surround the figure, with its upper part enclosed by a sort of canopy. The bishop Ewrad de Fouilloy was the founder of the existing cathedral of Amiens, commenced in 1220. He died in 1223; then his tomb was formerly placed on the axis at the entrance of the nave, and dates from the first half of the 13th century. It further possesses all the characteristics of that epoch.

The two other bronze tombs still remaining to us are those of Jean and of Blanche of France, children of S. Louis, before the revolution deposited in the church of the abbey of Royaumont under two niches decorated by paintings. These tombs are very small, and in hammered copper, gilded and engraved, and repres-





representing the two children on two plates of gilded and enameled copper, with rich borders likewise enameled with the arms of France, Castile and Arragon. The young prince places his feet on a lion, the princess has hers on a grayhound. Angels in half relief bearing censers are fixed beside the head of each, and religious also in half relief are detached from the ground beside the two personages. These two very interesting plaques are now deposited in the church of S. Denis, beside the main altar and opposite the tomb of Dagobert. <sup>1</sup>

Note 1.p.62. One of these is engraved in the *Monographie de l'église royale de S. Denis* by Baron de Guilhaume.

Horizontal tombs of copper, isolated like those of Charles the Bald and of the two bishops of Amiens, precious for the material and the work, as we stated above, were very probably protected on certain days by palls of rich fabrics, and lighted by candles. We have the proof of the last arrangement in the magnificent tombs of gilded and enameled copper, to be seen before 1793 in the church of Villeneuve near Nantes, and drawings of which are preserved to us in the collection of Gaignières. One of these monuments was erected over the grave of two princesses, Alix, countess of Brittany, who died in 1221, and her daughter Yolande of Brittany, who died in 1272, and dates from the last epoch. The clothing of the countess Alix even belongs to the years between 1225 and 1235. Was this figure already made then, or did the statuary desire to reproduce the costume of the princess, that died in 1221? We cannot decide the question; still one can admit that the statue of Alix was made after her death, as well as the plate on which it was fixed, (for the enameled ornamentation of that plate is evidently earlier than that of Yolande), and that after the death of the latter the two tombs were enclosed in the same base. However that may be, on the heraldic borders that enclosed and separated the two tombs were arranged 12 sockets in form of closed flowers, that were evidently intended to receive candlesticks and candles, as indicated by our Fig. 29. The very low base of the twin tomb is likewise covered by heraldic enamels. At the angles are four issuing lions of gilded bronze. The whole rested on a stone step.

At the angles of this stone plinth one nearly always finds the traces of metal fastenings or of bases of little columns



The first of these is the fact that the...  
...the second is the fact that the...  
...the third is the fact that the...

1941.1.1.1

The first of these is the fact that the...  
...the second is the fact that the...  
...the third is the fact that the...

The first of these is the fact that the...  
...the second is the fact that the...  
...the third is the fact that the...  
...the fourth is the fact that the...  
...the fifth is the fact that the...

The first of these is the fact that the...  
...the second is the fact that the...  
...the third is the fact that the...  
...the fourth is the fact that the...  
...the fifth is the fact that the...

The first of these is the fact that the...  
...the second is the fact that the...  
...the third is the fact that the...  
...the fourth is the fact that the...  
...the fifth is the fact that the...

supporting the iron frame on which was thrown a fabric on anniversaries or on certain occasions. Fig. 29 shows this arrangement.

Nothing equals the splendor of these monuments of gilded and enameled metal. The abbey of Braisne, the cathedrals of Beauvais and of Paris, and the abbey of Royaumont possessed several of them. <sup>1</sup>

Note 1.p.65. See Galignières, Bodleian Library, and the Monographie de S. Yved de Braisne, by Stanislas Prioux. (Paris. 1859. Didot edit).

There is a sort of monument intermediate between these last tombs and the horizontal tombs; these are statues lying on a slightly inclined bed, having a small height above the pavement. These tombs were placed in the choirs of churches or in chapels, so as to be seen by the believers and not to obstruct passage. Before the revolution, there existed a tomb so composed in the middle of the choir of the church of Chaloche; it was that of Thibaut, lord of Mothefelon, and his wife Beatrix of Dreux, and their son and daughter-in-law. The four statues reclined on a slightly raised base in form of a camp bed (Fig. 30); the statues were painted; the two lords of Mothefelon wore coats of mail with their arms, which are gules with 6 shields of or placed 3, 2 and 1. This tomb dated from the beginning of the 14 th century. <sup>2</sup>

Note 2.p.65. See Galignières. Bodleian Library.

Engraved horizontal tombs do not date before the 13 th century, as we have already stated. But about the end of the 12 th and the beginning of the 13 th centuries, there were placed in the churches many tombstones flush with the pavement, that presented the effigy of the dead in low relief. The respect of men for tombs caused the believers not to walk over these stones; but if there was a crowd in the church, it was very difficult to avoid striking against these projections, however small; hence men soon contented themselves with engraving on stone slabs or bronze plates the entire figure of the dead.

We possess in France a very great number of these horizontal tombs in relief. It will suffice to give here an example of them, found today among those deposited in the nave at the entrance of the church of S. Martin of Laon (Fig. 31). The tomb is of black Belgian stone, and is that of a knight wearing the military costume of the beginning of the 13 th century. His





shield is vairy; the sculpture of the person is of the natural size and projects very little from the ground, slightly hollowed. Further it is to be believed that these horizontal tombs, at least during the time between the death of the personage and the anniversary, was covered by a canopy of cloth. The form of those sculptured slabs is often that of a trapezoid, i.e., the stone is narrower at the feet than at the head.

The pavements of our churches at the end of the 15 th century, already were merely composed of tombstones laid side by side, and although a prodigious quantity of these monuments have been destroyed, so precious for the historical and archaeological studies, there still remain many. Several of these horizontal tombs are even of great beauty of style, and show to what degree of perfection the art of design had risen during the middle ages. The best of them belong to the 13 th and 14 th centuries.

The horizontal tombs of copper engraved or slightly modeled were all cast. Those that we still possess in some churches are of stone, sometimes with overlays of white marble for the nude, of black for certain parts of the clothing or for the ground. The incised line is filled with lead, black or reddish brown cement. The form of these tombs is too well known for it to be necessary to give examples here. We shall cite among the most beautiful those of the cathedral and the church Notre Dame of Chalons-sur-Marne, those of the churches of Troyes, of Beaune, of the S. Chapelle at Paris, etc. Gaignieres has left us drawings of several of those horizontal tombs from the abbey of Jumièges, and that were of enameled terra cotta.

Frequently these horizontal tombs were decorated only by an inscription engraved on the border and an emblem on the middle. Abbe Lebeuf cites a certain number of these slabs placed in the parish churches of the diocese of Paris, that had for the entire engraving a shield, a cross or a chalice. The latter are the tombs of priests. The tombstones placed on the tombs of Templars generally bore no inscription, but a simple Greek cross, a shield, and sometimes an equilateral triangle. (Art. Temple). <sup>1</sup> Men ceased to engrave the effigy of the dead on tomb slabs about the middle of the 17 th century.

Note 1.p.67. We shall have occasion in Vol. II of the Dictionnaire du mobilier français to give a great number of these en-





engravings on tombs, so precious for the study of costumes; that is why we give no examples here; besides, those objects are outside the domain of architecture.

#### TOUR. Tower.

In the old fortifications the tower is a work projecting from the curtains and forming a flanking sufficient for the use of guns.

It would be difficult to go back to the first use of the tower as a defense. The tower is known from the highest antiquity; Asians and Greeks, Phoenicians and Etruscans, built towers to fortify the walls of their cities and fortresses. Those towers were generally erected on a square or rectangular plan, and exceeded the level of the defensive gallery of the curtains.

The Romans had received the tower from the Etruscans and the Greeks, and after the epoch of the kings they flanked the curtains by means of towers with square plans. Around Rome, under the ramparts of the empire, of the late time of the middle ages, are still found numerous traces of those works built of great blocks of peperine by the Tarquins.

Still it is not rare to find Roman towers of a very ancient epoch, of circular plan and flanking the gates. At Arles are still seen on the side opposite the Rhone two bases of towers, that flank the gate, and that date from a very good epoch and are circular in plan. These towers are 26.3 ft. in diameter and are spaced 42.2 ft. apart. The so-called gate of Augustus at Nimes was flanked by two round towers. It was the same at the gates of Arroux and of S. Andre at Autun (4<sup>th</sup> century), at the gate of Vezone (Perigueux), east of the old cathedral. Roman towers on a circular plan and flanking curtains are much rarer; some are seen on the western front of the ramparts of Autun, but which belong to a very late epoch; the same at Rome.

The Romans also erected isolated towers outside the ramparts, a sort of advanced works that protected a weak point, the passage of a river, and commanded the country. Those towers took the place of what we call detached forts; they were sometimes connected by a vallum or earth wall with ditch, either with other towers or with the walls of the city. The edifice at Autun, to which is given the name of the temple of Janus, appears to have been one of those works, that formed the salient of a





wide bridge-head, of an intrenched camp on the right bank of the Arroux.

When the frontiers of the empire were menaced, the Roman emperors caused isolated towers to be built to protect the passages and to support the adjacent peoples. <sup>1</sup> Like the feudal keeps later, these towers had no doorways at the level of the ground, but at a certain height, so that one was compelled to use a ladder to enter. <sup>2</sup> The square tower of Autun just mentioned, seems to have had its doorway elevated above the external ground.

Note 1.p.68. (Latin note).Ann. Marc. Book XXVIII. Chap. 2.

Note 2.p.68. Thus were built the Roman towers of Besigheim at the junction of the Neckar and the Enz.

Certain Roman towers were merely posts for observation. "An unbroken line of these towers starts from Beuvray and is directed by Vielle Montagne toward the course of the Aron even to Decise by Coucy-la-Tour. The plain of Autun presents a similar line extending along the mountain chain to the northeast between the camps in the valley of the Arroux, above and below the city. It commences at the bend of the Arroux, on the right bank between Mont-Dru and Perriere, and crossing the basin of Autun on the highest points of the plain, ends at the valley of Barnay opposite the camp of the Mountain of Bar, so that none of the towers composing this line ever lose sight of each other. The memory of their beacons is preserved almost everywhere, either by name, or by popular tradition. The name of Montigny, Mons ignis, Mons Ignitus (mountain fire or burning), has remained in several of those localities." <sup>1</sup>

Note 1.p.69. See Essai sur le systeme defensif des Romains, etc., by J. Bulliot. p. 26.

The column of Trajan shows us in its reliefs many of those towers of observation with beacons, that permitted the concerting of military operations during the night, and of watching the movements of the enemy or the bands of pillagers during the day. When the government approached its dissolution, the first symptom manifested long before the great final crises is brigandage. The Roman empire in its decline, but long before the moment of its invasion by barbarians, was wasted by brigandage; armed bands were scattered not only on the frontiers of the empire, but around the great centres and even in the Campagna of





Rome. The last emperors were properly occupied in healing that ulcer of the government, that ended without succeeding in this. Constantine, Julian and Valentinian, established in Gaul lines of posts on the borders, along the valleys near the frontiers, and around the great cities. Those posts were nothing more than towers erected on ridges, natural or artificial hills. We shall soon see that this Roman system was long observed during the middle ages.

It is then proper first to distinguish the flanking towers, i.e., those attached to the curtains of a place, from isolated towers.

Vitruvius explains how flanking towers should be established; "they must," says he, <sup>2</sup> "project from the external face of the wall in such manner, that when the enemy approaches (the curtain), he will be taken in flank by two towers, one at the right and the other at the left. The walls of fortresses must be placed, not on a square plan presenting salient angles, but according to a circular perimeter (or approaching that figure), so that the enemy can be seen from several points, for salients are defended with difficulty, and are more favorable to the besieger than the besieged. The interval between the towers must be calculated according to the range of an arrow, so that the besieger may be repulsed by the casting machines operating on both flanks."

Note 2.p.69. Vitruvius. Book I. Chap. 5.

"It is necessary at the towers, for the curtains to be interrupted by a space having a width equal to the diameter of the tower. So that the defensive galleries being interrupted are only connected by carpentry foot bridges, that are not fixed by iron cramps and can be cast down, if the enemy has no possession of a part of a curtain, thus rendering impossible the occupation of other curtains and towers."

"Towers must be built on circular or polygonal plans, for if square, battering rams destroy them more easily by ruining the angles. If circular, each stone forms a wedge and transfers the shock to the centre, so that these towers better resist the effort of the machines. But nothing equals the terracing of the ramparts of towers to give them a greater power to resist."

These principles are the same that are accepted in our days, excepting modifications caused by the range of modern engines.





To see the enemy from several points, consequently to avoid salients flanked with difficulty; always to place the assailants under convergent fire; to arrange so that if a work be taken, this does not lead at once to the abandonment of others; to rely on the need of separating the works, such are the unchangeable principles of fortification. So far as we know, they were established by the Greeks and Romans, practised during the middle ages with marked superiority, singularly developed in modern times by reason of the use of cannon. In fact, from the round tower with short flanking and always having dead points, to the modern bastion with its flanks and fronts, there is a long series of experiments, trials and changes.<sup>1</sup>

Note 1.p.70. See *La fortification deduite de son histoire*, by Gen. Tripiet. Paris. 1868.

The Roman tower on a circular or square plan (for whatever Vitruvius taught, the Greeks and Romans erected many square flanking towers), was open or closed at the back, i.e., at the inside of the fortress. If open, the defensive gallery of the adjacent curtains was interrupted at that opening as Vitruvius indicates. If closed, the galleries on the curtains required two doors to be opened for entering or leaving the tower, to take the other curtains. In that case the tower formed an obstacle to the continuous passage at the level of the top of the ramparts. The first of these are retrenched towers, properly speaking, while the second are posts or little separate forts, commanding the ramparts.

What proves that this system of retrenched towers was by preference practised by the Romans, is that we see during the middle ages the use of this system persists in the cities, that have best preserved Roman traditions; while in the North, where Norman influence early makes itself felt in the art of fortification, towers are always closed, unless however they flank an external enclosure commanded by an internal enclosure.

We shall then divide this Article into:- Flanking towers, open or closed at the back; Fort towers, replacing or dependent on keeps; Watch towers; Isolated towers; Posts, signal towers, towers at passes or bridges; Lighthouses.

#### TOURS FLANQUANTES. Flanking Towers.

Flanking towers established according to Roman tradition, that continued in the West until the epoch of the great Norman





invasions, (at least when not dependent on gates), are generally solid to a certain height above the top of the ditch or the external ground, so as to resist the efforts of the attacking machines or of the sap; their flanking then commences only at the level of the defensive galleries of the curtains, and consists in quite wide openings masked by movable mantlets of wood. This first flanking is surmounted by the upper crenelated story forming the crown and the second flanking. This upper story is covered by a roof, so as to shelter the battlements, or if uncovered, the roof is then placed behind the defensive gallery or flush with it.

Here (Fig. 1) is a type of those towers of the end of the Roman empire, <sup>1</sup> open at the rear, but interrupting the defensive galleries of the curtains.

Note 1.p.71. Visigothic towers of Carcassonne; towers of Autun, Cologne and Poix; towers of Rome of the time of Belisarius.

Platforms laid on the engaged beam A allow the passage from one defensive gallery to another, and to enter the second story of the tower on a level. This first story is placed in communication with the third and with the battlements by wooden ladders. A movable ladder is raised by a windlass and connects the floor of the second story with the ground of the internal military road. This part of the ladder being raised and the platforms removed, the post guarding the tower could not fear a surprise; it is entirely isolated. Meanwhile it sees what passes in the city and can be watched. When the tower is occupied by the enemy, it cannot fight the military road, since the stories of that are open to the road. The supply of projectiles is obtained by these openings on the military road, as our Fig. indicates.

The tower is externally defended by openings made in the two stories and by the upper battlements. The wide embrasures in arched form are masked by movable wooden mantlets and swing on an axis.

The city of Carcassonne still possesses towers dating from the rule of the Visigoths, constructed on this principle, except that the defensive gallery passes through the tower, that is pierced by doors at the level of the defensive gallery. At Carcassonne the Visigothic towers have covered battlements, mantlets for the upper openings as for the openings in the sto-





stories, and wooden galleries to allow men to reach the foot of the defenses.

Here (Fig. 2) is the plan of one of these towers, <sup>1</sup> at the level of the defensive gallery. Below this level, the work is solid masonry.

Note 1.p.73. The tower called of Four S. Nozatre.

Fig. 3 shows the side of this tower with the section of the defensive galleries of the curtains. At A is sketched in place a frame of the defensive gallery; <sup>2</sup> at B is the perspective detail of one of the corbels of the upper battlements intended to receive the axes of the mantlets, and at C are the projecting stones set below the arched openings to also support the axes, that permit raising or lowering the shutters closing these arches. Above the floor placed at D is opened toward the city an arch, that allows seeing what passes in the upper story, and facilitates the supplying of projectiles. This arch surmounts the closing wall C (see plan), and rests on the two piers H, I.

Note 2.p.73. Article Bourd.

The question of the rapid supply of projectiles intended for defending these towers does not seem to have been examined with sufficient attention. One will note that these towers of an early epoch, i.e., that date from the end of the Roman empire till the last Carolingians, are generally of small diameter, and consequently could not contain a very large supply of projectiles, whether arrows or stones suitable to be thrown upon the assailants, that desired to approach the foot of the works and mine them.

Assuming that a tower, like that presented here (Figs. 2, 3), be attacked at its foot, that miners protected by cats attack the masonry; the defenders can only repulse this attack by casting on the cats from the defensive galleries large stones or burning materials to destroy them. If the attack be prolonged, one can estimate the considerable quantity of projectiles necessary to have at hand. It was then essential to renew constantly, as today it is to renew without ceasing the munitions of cannon placed on the works, that contributed to the defense of a point attacked.

These towers open at the back lent themselves to continual supplies, for their diameter being small, it was the more necessary to replace frequently the projectiles employed for the de-





defense. Besides the attack not being serious, except when very close, the point attacked defended itself without awaiting assistance from the adjacent works. All the efforts of the attack, and consequently of the defense, being thus limited to a very narrow area, the means of defense accumulated at the point attacked, and must be renewed with activity and facility. We shall see how this method of defense was gradually modified according to the improvements made in the mode of attack.

There is another observation to be taken into account. In the works of the end of the Roman empire, as during the Greek and Roman periods, the towers have a considerable command over the curtains (Fig. 4); <sup>1</sup> this arrangement is very regularly observed until about the middle of the 13 th century, but then the curtains rise higher; the command of the towers over the curtains diminishes accordingly. At that epoch it even sometimes occurs that these towers do not fulfil the function of flanking, and no longer command the curtains. It is again the system of attack that causes these changes. We shall have occasion to return to this subject.

Note 1.p.75. Gollo-Roman mosaic, museum of Carpentras.

By examining the angle towers of the castle of Carcassonne, whose construction dates in the first years of the 12 th century, one can take an accurate account of the means of supplying the upper defenses of these towers, for the works are perfectly preserved, the old carpentry alone being omitted.

Fig. 5 presents the plan of the northeast angle tower, called of the Major, at the level of the ground of the court of the castle. The round hall has a hemispherical vault, and is defended by 5 slots that strike the bottom of the ditch. Fig. 6 gives the plan of the second story, at the level of the defensive gallery of the curtains. The slots that open from the hall to the number of four, are not pierced above those of the great story, so as to leave as few dead points as possible. The vault covering this second hall is likewise spherical, and is pierced by a hole A or sound opening, that communicates with the upper stories. The third story is not vaulted but is covered by a floor placed behind the defensive gallery of the tower. This third hall was only destined for the lodging of the post in the tower, and was not defended. Above rises the battlements with the defensive gallery and a wooden gallery.





(Fig. 7). To facilitate placing the carpentry of the roof, the interior of the battlements is polygonal. The roof thus being pyramidal with framing that forms the transition between the pyramid of the cone. From B to C are assumed to be set the frames of the wooden galleries. These evidently projected very strongly, for the two superposed holes left in the construction to receive the trusses, indicate a system of ties with struts relieving the overhang of the horizontal timbers intended to carry the floor. The section on the line a b of the plan of the ground story (Fig. 8) shows the arrangement of the two lower halls pierced by slots, of the hall D, the chamber of the guard, and of the upper story, the post of the captain of the principal defense. The crane E vertically over the court of the castle allowed the hoisting of munitions to the top of the defenses, without its being necessary to carry them up the stairs on men's backs. By means of a windlass placed at G and a pulley at E passing through the tiebeam of the principal truss of the roof, a very considerable weight could easily be raised. Our section (Fig. 8) indicates this very simple mechanism. The bucket being hoisted above the level of the floor of the gallery, the trap was closed, the windlass released, and the munitions were placed along the wooden gallery or in the upper hall; for one will note that this hall is in communication with the wooden defensive gallery by the openings.

Note 1.p.78. Article Hourd, Fig. 1.

This hall being well furnished with stones and the galleries with arrows and tiles, it was possible to cover the assailants with projectiles for several hours. The machicolations of the galleries also projected and were usually double, i.e., allowed stones to fall at I and L. Materials falling from I bounced on the slope K and struck the assailants obliquely. (Art. Machicoulis).

Fig. 9 clearly explains, we believe, the mode of hoisting munitions. The man waits until the bucket is hoisted to the level of the floor before closing the trap and placing the projectiles where needed. At A is traced the horizontal section of the little double posts at the angles of the gallery, leaving between them a space for the planks covering the gallery. The floor of the upper hall being 4.2 ft. below the sills of the openings of the battlements, allowed the storing of a consider-





considerable quantity of projectiles, that the men posted in that hall passed as needed by the defenders of the gallery, so as not to encumber the defensive gallery. Even during an attack, men could hoist by the windlass caustic lime, boiling pitch, ashes, that blinded the assailants. <sup>2</sup> (Art. Siege). One will note that this angle tower, like all those of the defenses of the citw of Carcassonne, interrupts the passage on the defensive gallery of the curtains, and thus compels the recognition of the patrols at each turn. Besides, in these towers lodged the posts for defense, and each of these posts had to defend a portion of the curtain. The tactics of the assailants consisted in taking possession of a curtain in spite of the flanking, and thus passing into the place.

Note 2.p.78. As for melted lead and boiling oil, those means of defense were a little too costly to be taken seriously. Besides the melted lead falling from that height would arrive in cooled drops, which would not be feared much. It was only exceptionally that men had recourse to this means of defense. Simple boulders with a weight of 17.6 to 22.0 lbs. falling from a height of 65.6 ft. were the projectiles to armed men with armor.

Then the posts in the towers shut themselves within, and it was necessary to besiege them separately, which made possible an offensive by the garrison, that placed the besiegers in a very dangerous position. Yet from the middle of the 13 th century, it was desired to connect more the parts of the defense, and the height of the curtains was increased, thus renouncing the important command by the towers. In the last example that we present, the level of the defensive galleries of the curtains is at N; the command of the tower is thus very pronounced.

This command is already less considerable at the castle of Coucy, built about 1220. <sup>1</sup> The four corner towers of that castle are very remarkable, from the twofold point of view of construction and of defense. They are solid for the entire height of the slope. Five stories rise above this slope; two are vaulted, two are closed by floors, and the fifth is covered by a conical roof. <sup>2</sup>

Note 1.p.81. It is well understood that there is no question of the structures of the beginning of the 13 th century, due to Enguerrand. The curtains of the castle of Coucy were raised higher about 1400 by Louis of Orleans.





Note 2.p.81. For the system of construction of these towers, see Art. Construction, Fig. 144.

The plans (Fig. 10) present at A the northwest angle tower, at the level of the floor of the second story of the castle; at C at the level of the third story, at D at the level of the upper battlements.

The lower story is vaulted at the level of the ground of the court and has no slots; it is a cellar for provisions, whose vault is pierced by an opening. The stairs only ascend from the level of the court to the floor of the fifth story, and the story of the battlements is only reached by a wooden stairs (miller's ladder).<sup>3</sup> At g are fireplaces and at l are privies. An opening left at the centre of the floors permits hoisting munitions from the ground story to the top of the tower on the defensive gallery. The slots alternate so as to prevent possible dead points.<sup>4</sup>

Note 3.p.81. These stairs were extended to the level of the roofs under Louis of Orleans.

Note 4.p.81. Art. Latrines, Fig. 1.

The towers of the castle of Coucy present an interesting peculiarity, which is the transition from the wooden defensive gallery to the machicolations of stone.<sup>5</sup> Stone corbels replace the holes through which were passed the projecting timbers (as we have seen in the preceding example), that received the outer defensive galleries established in time of war. These permanent corbels then received the defensive galleries.<sup>6</sup>

Note 5.p.81. Arts. Bonjon, Hourd, Machicoulis.

Note 6.p.81. Arts. Hourd, Porte (the gate door at Coucy-le-Chateau).

Fig. 11 gives the section (on the line a d of the plan 7) of this beautiful work. Besides the openings of the slots, the halls of the fourth and fifth stories have a window in each, that lights them. Munitions were hoisted by a windlass placed in the hall of the fifth story, as shown by our Fig., and were deposited on the upper floor in communication with the wooden defensive galleries by means of covered openings. The defensive galleries sketched at G explain the system of wooden defenses set in time of war on the permanent stone corbels C. The level of the defensive galleries of the curtains being at R, it is seen that the command of the tower over this gallery





was already less important than in the preceding example.<sup>1</sup> At E commences the wooden stairs that passes across an arch of the hexagon and ascends from the fifth story to the level of the upper floor, very solidly built to receive the weight of a supply of projectiles.

Note 1.p.84. The upper part of the battlements is now destroyed, but is restored by the aid of engravings by Du Cerceau and by Chatillon.

This structure is marvellously executed in courses of 1.3 to 1.6 ft., and has suffered no alteration, in spite of the alteration of the pieces. The external slope descends to 26.3 ft. below the level K of the ground of the court. An external elevation taken from B (see plan), Fig. 12, completes our description. The wooden defensive galleries are placed on half the corbels.

These defenses of the castle of Coucy are constructed at the top of a precipice; their effect consequently could be exerted only on a very short radius, when the assailant sought to lodge himself at the very feet of the towers.

Slots are pierced in each story, rather to take into account the movements of the enemy than for shooting. It was here necessary to oppose to attacks an obstacle, formidable by its elevation and by the defense at the top. In fact in three sides, the castle of Coucy leaves between its walls and the crest of the hill only a width of some yards, an external passage that could itself be defended. A very broad ditch and the great keep protect the fourth side.<sup>2</sup> There was only a near and almost vertical defense. But the situation of the place often required then as today, to supplement the natural obstacle of a precipice by a range of fire as extended as possible horizontally, so as to annoy the approaches. This condition is habitually fulfilled by low works, external flanking enclosures, dominated by the command by internal works. The very complete enclosure of Carcassonne in that respect furnishes us with arrangements of great interest. It is known that the city of Carcassonne is protected by a double wall; the external one has an unimportant command; on the contrary, the inner one dominates that external enclosure and the country.<sup>3</sup> Now the external enclosure was built about the middle of the 13th century by the order of S. Louis, and is flanked by towers, mostly closed at the rear and





spaced from 164 to 197 ft. apart. Those towers have but little command over the curtains, and sometimes are even united with them, are arranged for distant defense. Well equipped with slots, they project beyond the walls and receive projecting defensive galleries.

Note 2.p.84. Art. Chateau.

Note 3.p.84. Arts. Architecture Militaire, Fig. 11; Siege, Fig. 2.

One of those towers is entirely preserved and presents an arrangement conforming in all points to what we have just indicated. Fig. 13 gives the plan of this tower at the level of the ground of the lists, i.e., the military road made between the two enclosures. Fig. 14 gives the plan of the second story. The defensive gallery of the curtain is at A, and the tower does not interrupt the passage.

Note 1.p.86. Tower called la Peyre, at the left of the barbican of the gate Narbonne.

The door B connects the defensive gallery with the ground story by the stairs D, with the second story on a level, and with the upper defenses by the stairs C. The numerous slots are alternated to avoid dead points. Fig. 15 presents the plan of these upper defenses, the wooden gallery being assumed as placed at E. The battlements are widely opened at G to allow supplies and so that the work cannot be defended against the inner wall, that further possesses a very important command. In time of peace, the circular space H alone was covered by a permanent roof. The roofs of the defensive galleries placed in time of war covered the inner and outer defensive galleries K and L; a wide hood protected the opening G. The section made on the line a b of this plan is presented in Fig. 16. At M is sketched the profile of this entire work with the ditch, the crest of the counterscarp and the ground forming the glacis. One sees how the slots are arranged to cover this glacis with sweeping projectiles, and the crest and foot of the counterscarp with plunging projectiles. As for close defense, it is provided by the machicolations of the defensive galleries, as one sees at P. Fig. 17 gives the elevation of this tower from the inside, the defensive gallery being placed only on the side R.

If the assailants succeeded in obtaining possession of this work, they found themselves at 66 ft. from the foot of the in-





inner wall, whose towers were closer but projected less from the curtains, presenting a front with many short flankings. From the top of that inner enclosure, whose height is 49.2 ft. above the covered way S, it was not difficult to set fire to the roofs of the towers of the outer enclosure by means of incendiary projectiles, and thus make its occupation impossible, the more as these towers did not defend themselves from the military road of the lists.

With the casting machines and the means of attack of that epoch, one could not adopt a better defensive combination. Thus the towers were solid for the height of the slope covering the natural rock, and could not be ruined by mining. Well pierced by slots, they cast divergent projectiles directly to 200 ft. from their circumference. To attack them, it was then necessary to undertake a series of works, that required time and many men; while to defend them sufficed a less numerous post. A work of this extent could long defy attacks with a captain and 20 men. <sup>1</sup> If the attack were very close, the lower slots became useless, and then the 20 men distributed on the wooden galleries covered the assailants with a storm of projections. We have stated elsewhere (Art. Architecture Militaire) that the besiegers rather directed their systematic attacks against the curtains, than against the towers, because the curtain possessed less means of defense than the towers, and that it was more difficult for the besieged to fortify them. But it is unnecessary to say, that to take a curtain, it was first essential to destroy or mask the flankings by the adjacent towers.

Note 1.p.89. Eight crossbow men in the two lowest stories easily serve 16 slots.

	8 men.
One attendant in each story	2 men.
Eight crossbow men in the galleries	8 men.
Two attendants for the machicolations	2 men.
A captain of the tower	1 man.
Total	21 men.

The external walls of Carcassonne have 14 towers; assuming each to be guarded by an average of 20 men, making 280 men.

Twenty men in each of the three barbicans 60 men.

One hundred men to serve the curtains at the points of attack 100 men.

The external walls comprise 24 towers averaging 20 men each 480 men.





For gate Narbonne	50 men.
To guard the curtains	100 men.
For garrison of the castle	200 men.
Adding a captain for each post and tower, according to custom	-----
We obtain a total	1320 men.

This number is more than sufficient, since the two walls do not have to be defended simultaneously, and the guard in the inner enclosure could send detachments to defend the external enclosure, or if that had fallen into the power of the enemy, its defenders would take refuge behind the inner enclosure. Besides the besiegers would not attack all parts at the same time. The perimeter of the external enclosure being 4593 ft. inside the ditches, then about one man to 3.3 ft. of length must be counted to form the garrison of a city fortified like the city of Carcassonne.

While the towers enfiladed the curtains, men could scarcely bring the cats and rolling towers against these curtains. Thus although it did not conform to tactics to send an assaulting column against a tower, -- and the rolling towers were only a means of throwing an assaulting column on the curtain, -- it was always necessary for the assailants to nullify the defenses of the towers on the flanks, before undertaking anything against the curtain.

But admitting that the wooden galleries of the towers had been destroyed or burned, and that their defenses had been reduced to the slots of the lower stories, that the rolling towers were near the curtain; the defensive gallery of the curtain was always elevated above the ground inside, and the assailants throwing themselves from the rolling tower on those defensive galleries were taken in flank by the defenders, who sallied from the adjoining towers as from forts, at the moment of assault, as a provision for this occurrence, although the towers intercepted communications between one defensive gallery and another, these towers had doors opening directly on these defensive galleries, permitting the posts in the towers to throw themselves on the flanks of the assaulting column.

Here (Fig. 18) is one of the towers of the external wall of Carcassonne, built by S. Louis, which exactly fulfils this programme. This is the tower on the north front, called the Port-





Rouge (Red Gate). This tower has two stories below the battlements. As the ground rises sensibly from a to b, the two defensive galleries of the curtains are not on the same level; the gallery b is 9.8 ft. above the gallery a. At A is traced the plan of the terrace; at B on the level of the gallery d; at C on the level of the battlements of the tower, that sweeps the battlements of the curtains e. One sees at d the door that descends to the lower story A, and at e is the door that opens on the higher defensive gallery, communicating to the second stairs descending to the story B. One passes outside the battlements of the tower by the stairs g. Further the two stories A and B are connected together by an internal stairs h h', made in the thickness of the wall of the tower. Thus the men were posted in the two stories A and were alone in direct communication with the two defensive galleries. If the besiegers have succeeded in destroying the wooden galleries and the upper battlements, and if they believe that they have rendered the work indefensible, and they attempt to assault the curtains, they are received in flank by the posts established in the lower stories, which being easily masked, could not be overthrown by projectiles from the stone-throwers, or made uninhabitable by burning the roof of wooden galleries. A longitudinal section made of the two defensive galleries from e to d shows that arrangement (Fig. 19). It is seen that e' is the door of the stairs e, and d' that of the stairs d (of the plan). The last d door is defended by a watchtower f, reached by a flight of 6 steps. At h" commences the stairs which connects the two stories A and B. A layer of earth placed at K prevents fire, which could be set to the wooden gallery and the roof by the besieged, from communicating to the two floors that cover these two stories A and B.

Fig. 20 gives the section of that tower on an axis perpendicular to the front. At d" is the door opening on the stairs d. The wooden galleries are placed at m. At p is sketched the profile of the precipice with the extension of the lines of fire from the two rows of slots of the stories A and B.

It is unnecessary to state that the wooden galleries sweep the foot of the tower.

A perspective view (Fig. 21), taken from the military road b between these two enclosures (point X of the plan), will illus-





illustrate the internal arrangements of this defense. Supplies for the wooden galleries and the defensive galleries of the tower are made by opening c (of the plan C), by means of a hoist and pulley, as shown by the perspective sketch.

Here the tower commands only one of the defensive galleries (section, Fig. 19). At its construction under S. Louis, it commanded both defensive galleries; but under Philip the Bold when the defenses of the city of Carcassonne were terminated, the heights of some curtains were increased, which do not seem to have been commanded by a sufficient height. At that epoch the battlements G were placed above the old battlements H without taking the trouble to demolish the latter, so that externally these first battlements H remain enclosed in the raised masonry. In fact, the external ground rises like the military road from a to b (see plan), and the engineers believing that they should adopt a uniform command of the external curtains, both for the outer and the inner walls, all these heights were made regular at about 1285. It must also be stated, It must also be stated, that at this epoch they rarely gave to the towers any important command except at the angles of fortresses, or at some places where it was necessary to observe the exterior.

For the great fronts, the flanking towers do not command the curtains, and this arrangement is observed for the great south front of the internal wall of Carcassonne, rebuilt under Philip the Bold.

The city of Carcassonne is an inexhaustible mine of information on the art of fortification from the 12th to the 14th centuries. There are not found scattered fragments much altered by time and the hand of man, but an entirety coordinated with system, nearly intact, constructed of strong materials by the skillful engineers of the 12th and 13th centuries, as being a military point of very great importance. When Carcassonne was comprised in the royal domain under S. Louis, that place at a point distant and badly connected with the possessions of the crown, became a bridge-head protecting a notable part of Languedoc against Arragon.

All the defensive arrangements still found in France and dating from this epoch, have not the unity of conception and the value of the fortifications of Carcassonne. Hence it will be understood why we have chosen by preference our examples in





that place of war, that happily today by the efforts of the government and the interest that the people of Carcassonne took in that fortress, unique in Europe, is preserved from the ruin that so long menaced it.

The arrangement of the last tower of the external enclosure just given by us is such, that this work could not defend itself against the inner wall; for not only is that tower dominated by far, but is nothing of a defense inside.

All the works of this outer enclosure are in the same situation, although much varied in their arrangement by reason of the nature of the ground outside, and the needs to be satisfied. There is only one point where the external wall is connected to the internal defense by means of a tower built across the military road, which separates the two fronts. This is a work on a rectangular plan, placed as a watch-tower, flanking at once the external curtains and the lists (military road) and the internal curtains; allowing one to see, without leaving the inner defense, the ascent at the gate from the Aude, all the front as far as the western salient of the place defended by two great angle towers, and the part nearest the suburb of the barbican. This tower, called that of the bishop because it overlooks the episcopal palace, is an admirable work, built of beautiful hard sandstone with bosses, and belonging to the works completed under Philip the Bold.

Note 1.p.95. See the general plan of the city of Carcassonne, *Art. Architecture Militaire*, and the Archives of the monuments historiques.

Here are the plans of the different stories (Fig. 22). At A on the level of the lists or military road between the two walls, the battlements of the external enclosure being at a and the curtain of the inner enclosure at b. -- The second story is traced at B. From the terrace of the city, this story is reached by the stairs d, which ascends to the two upper stories. The plan C gives the story of the battlements with its front wood gallery e. The defensive gallery g connects with the gallery h by passing through the door i, and ascending several steps to reach the level of the hall k and descending again by the screw stairs. Two machicolations at m and n (see plan B) command the two branches across the military road.

Fig. 23 gives the section of this work made on the line o p.





The level of the lists is at A, the level of the ground inside the city being at B. Besides the two machicolations pierced in the archivolts of the passages P, in time of war wooden galleries were established on the third story above those arches, as indicated by the sketch D and the profile d; galleries to which the openings C gave access. A wooden gallery placed at E on the front of the tower commanded its foot and flanked its angles. The profile F gives the section on the internal curtain, the lists and the external curtain. All stories are connected by openings pierced at the middle of the cross vaults. These openings permit supplying the upper stories with the munitions necessary for serving the galleries.

Fig. 24 presents the perspective view of this tower outside the external enclosure with the wooden galleries placed everywhere. It is seen that the slots of the battlements have their field of fire below the galleries, which permits two lines of crossbow men or archers to defend the works, since the galleries have slots above the machicolations. The corner turrets are octagonal, afford a divergent fire, and are flanked by the slots in the sides of the galleries. This tower has the advantage of enfilading the military road between the two enclosures, of cutting it off entirely at need, and of possessing flankings of the scarp and of the external enclosure. Perfectly preserved, built of unchangeable materials, it could be utilized by means of works of small importance.

All the works undertaken at Carcassonne under Philip the Bold have a remarkable character of strength, and indicate profound knowledge of the art of fortification, having regard to the means of attack of the epoch. The flankings being near, it is impossible to combine them better. The garrisons were then composed of men of all sorts, lieges and mercenary, and it was necessary to mistrust possible treasons. These towers were independent forts, intercepting passage along the defensive galleries and even on the lists, as seen in the preceding example. Each being commanded by a captain, the surrender of one did not lead to the fall of the others. The citizens could not ascend to the defensive galleries, which had a considerable height above the terrace, and only communicated with the ground inside by very rare stairs generally passing through posts. Every attempt at treason became difficult and doubtful, because it





was necessary, either to take many persons into confidence in the means to be employed, or that it should remain isolated, therefore being promptly suppressed.

Sometimes the defensive gallery of the curtain extends around the flanking work and contains a post; but then the tower has all the character of a fort or little keep possessing its means of defense, for offensive return and retreat, being independent. Several towers of the internal walls of the city of Carcassonne are conceived on this system. One of them, the so-called tower S. Martin, is well preserved and clearly explains this arrangement to us.

Built on the south front near the postern of S. Nicaise, the tower S. Martin rises 32.0 ft. above the military road of the lists and 50.9 ft. above the ground in the city. It has two lower vaulted stories, and two upper stories below the roof with an intermediate floor at the level of the wooden galleries. Fig. 25 gives at A the superposed plans of the two lower stories, and at B the superposed plans of the two upper stories. Examining these plans with some care, one observes that the cylinder of masonry is thicker on the outside than towards the interior of the city; in other words, that the circle of the interior is not concentric with the exterior of the tower; that this external front is reinforced by a spur or projecting beak *Q*. This spur and the greater thickness given to the masonry result in neutralizing the effects of the battering ram, and place the assailants under the direct fire from the adjacent flankings. (Arts. Architecture Militaire; Porte). One enters the tower from the city by the door P, and the straight stairs ascending to the second story. From this second story, by the screw stairs one descends to the lower story and ascends to the upper stories.

The battlement story, and that can be equipped with wooden galleries, is in communication with the defensive gallery and the curtains by the two doors K and L. This gallery extends around the upper story on the side next the city at G. A section made on a b (Fig. 26) permits easy understanding of these arrangements. The story H contains a fireplace and is lighted by a window F looking on the city. Wooden galleries were placed at I according to custom. The slots of the two lower halls alternate as indicated by the plan. <sup>1</sup>





Note 1.p.101. The slots of the ground story are hatched, like the door leading from that story to the screw stairs.

This work and the preceding belong to the structures of Philip the Bold, and consequently date from the last years of the 13<sup>th</sup> century.

Sometimes at that epoch to extend the flankings of the towers, there is given to them in plan the form of a pointed arch.<sup>2</sup> On this plan are built some of the towers of Loches.

Note 2.p.101. Art. Architecture Militaire, Fig. 24 bis.

The great machines for attack were then perfected; there were opposed to them walls built solid without stone, thick merlons, defensive galleries built of great timbers; several vaulted stories were arranged to protect the posts from projectiles thrown in a curve. They sometimes returned to the square tower as having longer flanks and fronts, that were protected by strongly projecting wooden galleries, and soon by stone machicolations.

The towers of Aigues-mortes were built by Philip the Bold and are rectangular in plan; the same plan was adopted for the greater part of the towers of the walls of Avignon. It must be stated that an entire front of these ramparts was arranged under Pope Innocent VI by Jean Fernandez Heredia, commander of M Malta, and that the arrangements then adopted were successively followed from 1350 to 1364.<sup>3</sup> Most of these towers project very far from the curtain, whose defensive gallery passes behind them or is interrupted by the sides. Further, these towers are generally open at the rear.

Note 3.p.101. Most of the military works of the orders of the Temple and of Malta present square towers. (See Essai sur la domo franc. en Syrie pend. le moyen age, by E. G. Rey. 1866.

Fig. 27 presents the plan of one of those towers of Avignon in the ground story. A stairs E, closed by a door, permits one to ascend to the second story, (Fig. 28), which communicates by two exits with the defensive gallery of the adjacent curtains G and H. A second corbelled stairs ascends to the upper story with battlements (Fig. 29), pierced by machicolations. As one can see, this tower is only defended from its top. The perspective view (Fig. 30) taken from the city side, completely explains the system of defense, and indicates the means of access to the two stories. Open at the rear, it cannot be regarded as an independent fort at need; yet the defensive galleries of the





curtains are interrupted like the Roman towers mentioned by Vitruvius. Its external area permits assembling on its top a very great number of defenders. If the assailants succeed in undermining its front at K (Fig. 27), it would still be possible to defend the breach, either by fortifying the rear front, or by overwhelming the enemy by dropping projectiles through the great machicolations opened in the middle of the floor of the second story. We have assumed the roof to be removed, so as to show better the system of defense, but it was placed over the upper space and sheltered the floor of the second story and the ground of the ground story.

Already at the middle of the 14<sup>th</sup> century men began to make use of cannon. However those cannon had but a small calibre and mediocre range, and could not produce a serious effect on masonry, even if rather thin.

The old great siege engines, stone-throwers, mangonels and trebuchets, casting stone balls weighing 220.5 or 330.7 lbs and sometimes more, in a parabola, were more formidable than the first pieces of artillery. The projectiles cast by those great machines could only produce an effect when they passed above the defenses and fell, either on the roofs of towers or within the places. Du Guesclin, although he did not make very much use of these war machines, and preferred to make a sudden attack, sometimes employed them, and when he placed them in battery before a fortress, this was always to demoralize the garrison by the quantity of projectiles by which he covered the streets and houses. <sup>1</sup>

Note 1.p.104. "And (du Guesclin) went his way and his return, and all the lords of France in his company, to come again before the city of Usson in Auvergne, and besieged it; and there the duke of Berry, the duke of Bourbon and the constable caused to be brought and hauled great engines from Riom and from Clermont, and placed before the said fortress, and with all that to arrange great preparations for assault." (Froissart. Chron. 329).

If the defenses were very high, the projectiles could only strike their surfaces directly, and could not injure them. <sup>2</sup> The troubadour Cuvelier in the Life of Bertrand du Guesclin relates, how at the siege of the castle of Valognes, at each stone cast by the engines of the besiegers, a man of the guards wiped the stones with a white napkin in derision. He also takes





care to tell us in the same passage, how the garrison covered the terraces with manure to prevent the effect of projectiles thrown in a curve. (Old French poem).

Note 2.p.104. Old French poem. (*Le Vie uoillant* . Bertran du Guesclin, by Cuvelier, troubadour of the 14 th century. Verse 5076 et seq.).

The great power then given to the machines compelled the military architects to increase the heights of towers and curtains. But if necessary for a place covering a great area, these curtains could not be given a very great height without considerable expense; thus under Charles V new arrangements were made. Until then men had but exceptionally thought of terminating towers by platforms suited to receive machines. These machines were placed in position on platforms of wood constructed inside along the curtains, or even on the ground behind them, when they had but a small height, or again along the lists, when the places had double walls, so as to keep off assailants. But when the first wall was taken, there was no longer anything but a very near defense, and then the casting machines became useless, and the wooden galleries or the machicolations sufficed.

Under Charles V, let us say, men modified the old defensive arrangement. They already possessed small guns, which permitted lengthening the fronts, and consequently making the flankings more distant. Men had recognized that short fronts had the inconvenience, if the two adjoining flanks had been destroyed, of concentrating the assailants and presenting only an obstacle of small length, against which they could accumulate his means of attack. Thus it was always against these short curtains between two towers, that the last operations of a siege were concentrated, as soon as had been previously ruined the upper defenses of the towers by fire, if they consisted of wooden galleries, or by great projectiles, if those galleries and machicolations were faced with masonry. About 1360, the curtains were made longer; the towers were spaced farther apart and occupied a greater area, sometimes had straight flanks, i.e., these towers were built on a rectangular plan, and were crowned by platforms. The castle of Vincennes is a fortress type conformed to the new arrangement. The well known plan of the place <sup>1</sup> presents a great parallelogram flanked by four rectangular towers at the angles, of one (gate) tower also rectangular and at the





middle of each end, of three square towers on one long side, and by the keep with its enclosure on the other.

Note 1.p.106. Art. Architecture militaire, Pl. 41.

The curtains are 328 ft. long, which exceeds the limit of the old flanked walls.

The angle towers are so placed that their flanks are longer at the ends of the parallelogram than at the sides, so as to better protect the gates.

Here at A (Fig. 31) is the plan of one of those angle towers in the ground story, i.e., at the level of the ground of the place. Great buttresses resting on a slope rise to the upper cornice, which is merely a series of wide machicolations. The three stories were vaulted, and on the last vault rested a stone slab platform, very suitable to receive either great machines or cannon. A parapet protects the crossbow men. At B is traced the plan of this platform.

Fig. 32 gives the elevation of this tower on its longer side with the adjacent curtain. One recognizes here that about the second half of the 14th century men returned to a considerable command of towers over the curtains, with the evident intention to utilize that command for placing machines of long range. The upper vault was covered by a thick layer of stone dust<sup>1</sup> under the stone slabs, and resisted all projectiles thrown in a curve, assuming that these projectiles could rise sufficiently high to fall on the platform.

Note 1.p.108. This "craie" is the dust produced in stonecutting, and that is gathered on the yard. It was much used during the middle ages to cover vaults, that it was desired to protect from projectiles or fire.

The tower only defended itself entirely from the top, either by fixed machines, or against close attack by battlements and machicolations.<sup>1</sup>

Note 1.p.109. These towers were razed to the tops of the curtains in 1814. (See the large engravings of Israel Sylvestre, *Les plus excellents bastiments de France*, etc).

It is curious to follow step by step from antiquity this constant movement of oscillation, that in works of defense sometimes causes men to give to towers or flankings a command over the curtains, and sometimes reduces this command and razes the tops of towers to the level of the curtains. Again in our days





these oscillations make themselves felt in the art of fortification, and Vauban himself at about the end of his career had returned to commands elevated on bastions, after having recommended flankings on a level with the curtains.

In fact, whatever the range of projectiles, that is only a relative question, since the conditions of fire are equal for the besieged as for the assailants. If the elevated commands are suppressed, the assailants are exposed at a smaller distance, and they are permitted to commence near their works of approach; if one increases this command, greater facility is given to the artillery of the besiegers. Thus we see during the middle ages and principally since the adoption of cannon, that the systems succeed each other and vary between the two principles.<sup>2</sup> Besides a difficulty arose formerly as it rises today.

Note 2.p.102. In our time we have seen German fortification return to elevated commands, to towers with bastions.

The trace of a place in horizontal projection may be rational, and not be so because of the relief.

With elevated commands, one can see the country afar, but enfilades the ditches and scarps by a plunging fire, that does not produce the efficient effect of a sweep fire. It is then necessary to combine these two conditions.

We shall soon see how the last military architects of the middle ages attempted to solve this twofold problem. The castle of Vincennes, for the time when it was erected, is no less an attempt at this, all whose importance has perhaps not been appreciated. The architect constructor of the defenses has claimed to relieve his towers from the effect of parabolic fire by giving them a considerable height, and he has claimed to utilize this command, then unusual, for the fire of the new guns and the great perfected machines, such as mangonels and trebuchets.<sup>3</sup>

Note 3.p.104. Article Engin.

Under the reign of Charles V one finds nowhere in France, Italy, England or Spain, a second example of the arrangement adopted for the construction of the castle of Vincennes. This is an isolated attempt that was not followed; here is the reason; then (from 1365 to 1370).<sup>1</sup> men scarcely began to employ cannon of very small calibre, or short iron mortars, hooped and suitable to throw stone balls in a curve, just as could machines





with counterpoises. Men did not believe that the new artillery would replace a century later those cumbrous machines, but whose fire was very accurate and with terrible effect up to a range of 492 to 656 ft. The cannon employed about the end of the 14th century in places consisted of wrought iron tubes and threw balls of 2 or at most 3 lbs, or even round boulders. These engines replaced with advantage the great crossbows, and could be placed in battery behind the merlons of towers. There was then an interest in increasing the height of these towers, for the direct fire being weak, the more it was raised, the more it could damage the besiegers. Besides, as we have just stated, it was important to relieve the tops of these towers from projectiles thrown in a curve by the old machines. The curtains came relatively to have but a small height, so as to post crossbow men, who shot their bolts point blank up to about 200 ft. The machines and cannon on the platforms of the towers covered the country with great projectiles in a radius of 656 ft., and thus keeping the besiegers at a distance, the curtains were protected up to the moment, when by the works of approach, the assailants reached the crest of the ditch. In this last case the crossbow men of the curtains protected them from approach, and those on the towers took in flank the assaulting columns by a plunging fire. But although the progress of course was slow, still at the end of the 14th century besieging armies commenced to place mortars in battery. These being covered by embankments and gabions did not have to fear much the rare engines placed on the tops of the towers, but concentrated their fire on the relatively low curtains, dismantled their parapets, destroyed their machicolations, rendered the defense impossible, and the besiegers could then proceed to make a breach by mining. The elevated commands of the towers became useless as soon as the enemy reached the foot of the scarp. About 1400 the system was then changed, the curtains were raised to the level of the towers; the built defense was reserved for close attacks, and outside that defense were erected advanced works on which were placed the guns in battery. Those were then reserved to equip these low and extended works, covering the country, and the fortress was no longer more than a sort of fort only intended for near defense.

Note 1.p.110. The castle of Vincennes, considerable remains





of which one to be seen today, was commenced by king John on new plans; but if one considers the style of the architecture, it does not appear that the predecessors of Charles V ever raised the work above the ground of the place; even if Charles V did not entirely rebuild the work.

In fact, we see that the castles built at that epoch established defenses of the curtains nearly at the level of those of the towers, leaving to the latter a command a little higher, for the oversight of the exterior, and that many of the old curtains of the 13<sup>th</sup> and 14<sup>th</sup> centuries are raised up to the level of the defensive galleries of the towers.<sup>1</sup> Then men entirely renounced placing guns in battery on these towers, the platforms disappeared for a time, and artillery was employed by the defense only to sweep the approaches.

Note 1.p.111. This fact is very apparent in the works undertaken by Louis of Orleans at the castle of Coucy and of Montepilly near Senlis.

The castle of Pierrefonds was entirely built by Louis of Orleans, and furnishes us with precious data in that respect. Not only the works of excavation and restoration undertaken in that fortress have permitted the exact recognition of the arrangement of the towers and curtains, i.e., of the close defense, but they have brought to light a series of advanced works of small height, that formed a zone of defense to receive artillery. These works explain how the troops sent on two occasions by Henry IV with artillery to take this castle, could not get possession, and how in the minority of Louis XIII, it was necessary to undertake a regular siege to reduce it.<sup>2</sup>

Note 2.p.111. These works were commenced in 1858 by order of the emperor, and in great part by means of credits opened on his majesty's privy purse.

These observations will illustrate only the towers of Vincennes, that date from the reign of Charles V, possess platforms suitable for placing artillery, and why they have a considerable command of the curtains, while the towers of the castle of Pierrefonds, built about 30 years later, present no arrangement suitable to receive cannon, and have but an insignificant command of the curtains. We see that after 1400, the military architects follow step by step the progress of artillery, sometimes giving to these cannon a command of the country, sometimes pla-





placing them at the bases of the towers, and reserving them to sweep the crests of the ditches; sometimes making them independent of the old defenses retained, and employing them to retard the works of approach by means of advanced works, ramparts, cavaliers, etc. <sup>3</sup>

Note 3.p.111. Articles Architecture Militaire, Boulevard.

Fig. 33 gives the plan of the ground story of one of the towers of the castle of pierrefonds, <sup>4</sup> at the level of the ground of the court and above the two stories beneath that ground. At A are barracks against the curtains B. Conformably to the customary arrangement, it is necessary to enter the tower occupied by a post to reach a stairs ascending to all the stories. The doorway of the post is at a. Three windows light that room, n near which are found the privies at b. At c is a fireplace.

Note 2.p.111. Tower of Hector.

The section on f e (Fig. 34) explains the various services of this work. The level of the defensive gallery of the curtains is at V, and the upper battlements of these curtains at t the base of the roofs of the buildings are at the level G of the defensive galleries of the towers; thus these towers have only the command G K over the curtains.

The four upper stories, including the ground story, are covered by floors, but the two stories below the ground of the court, which is at L, are vaulted. One even notes that the vault V is covered by a thick layer of rubble, that protects it from fire or the fall of the upper parts.

The screw stairs stops at the level of the floor of the second cellar, for the first cellar B is a dungeon into which one descends only through the opening pierced at the middle of the ellipsoidal vault constructed by horizontal courses corbelled. O One cannot doubt that this cellar was destined to serve as a dungeon or prison, since it has a privy C and little vault.

The ground of the lists or of the external military road is at the level P beside that tower.

The dungeon B receives neither air nor light from the outside. One notes that the masonry of the cylinder at the level P is 17.1 ft. thick, and that behind the facings of cut stone inside and outside, this masonry is composed of well bedded rubble and of great boulders of extreme hardness. <sup>1</sup> It was then not easy to sap a work so constructed, defended by a circle of ma-





machicolations of the defensive gallery G. This work dates from 1400. No trace of the upper platforms to place large guns in battery. Mortars, "passe-volants, veuglaires, basilics" and culverins were placed on the outer works, i.e., on the crest of the plateau that served as base for the castle, so as to strike surrounding valleys. The upper defensive galleries were occupied at the time of the construction of the castle of Pierrefonds, only by crossbow men or archers opposing a near attack.

Note 1.p.114. It required 27 days for a skilful workman to make a hole about 3.3 ft. square in one of these walls above the batter, i.e., at the point where the masonry was only 13.1 ft. thick.

Yet from the day that the besiegers possessed artillery of sufficient calibre to be able to batter the outworks and extinguish their fire, it was necessary that the last defense, the castle, could oppose cannon to the assailants. Then from the epoch of the war against the English, the architects endeavored to find means of placing guns on the towers.<sup>2</sup> To obtain this result, they gave them less height, increased the thickness of their circular walls and vaulted them to support a platform; or indeed retaining the old system of upper defense of the 14 th century intended for crossbow men, embrasures for cannon were pierced at the bases of these towers, if they were built on an inclined site, so as to batter the approaches.<sup>3</sup>

Note 2.p.114. At the siege of Orleans several of the old towers of the walls were terraced to receive artillery.

Note 3.p.114. In Art. Chateau, see the description of the defenses of the castle of Bonaguil (Figs. 28, 29).

It must be stated that then the cannon that threw projectiles point blank were of small calibre; those pieces shot lead balls, but more frequently of iron pyrites or small spheres of hard sandstone. The latter projectiles could not have a long range. As for the great cannon reserved for the exterior or the platforms of towers, during the course of the 15 th century, they rarely threw any but stone balls in a curve, i.e., a parabola. However at the time of the siege in 1428, the artillerists of Orleans possessed cannon sending balls point blank to 1969 ft;<sup>4</sup> these guns were all placed on the old towers or on outworks;<sup>5</sup> as for the curtains, they were equipped with machicolations and galleries of masonry or of wood. In fact for a long time the





artillery was placed in battery on the towers to command the approaches, or at the base of the towers to enfilade the ditches and protect the curtains, that only defended themselves by the aid of the old arms against a near attack. Thus at the end of the middle ages the part of the towers takes more, instead of less importance. More distant from each other, they projected more from the curtains in order to flank them better; they were sometimes almost entirely detached, especially at salients; their diameter was considerably increased, reinforcing their walls and they are casemated. Often even the upper battery, instead of being uncovered, is protected by a shell of masonry and earth. We cannot state whether that innovation of covered batteries is due to France, Germany or Italy. Francisco di Giorgio Martini, architect of Siena, who lived at the middle of the 15<sup>th</sup> century, gives several examples of those towers with covered batteries in his Treatise on military architecture.<sup>1</sup> We have found in France traces of these coverings in works in the form of towers protecting salients,<sup>2</sup> and that did not forbid the use of the old machicolations and parapets.

Note 4.p.114. Art. Siège, p. 426.

Note 5.p.114. Art. Boulevard.

Note 1.p.115. Trattato di architettura civile e militare by F. G. Martini, first published by the care of the chevalier Cesar Soluzzo. Turin. 1861. See the atlas, pls. 5, 22, 23, etc.

Note 2.p.115. At Longres, at Dijon, the old castles, 15<sup>th</sup> century; at Marseilles, end of 15<sup>th</sup> century (demolished north front); perhaps at the castle of Ham before the reconstruction of the platform of the great tower, built by count S. Pol, whose walls are 32.8 ft. thick.

Here (Fig. 35) is an example of these sorts of towers. At A is traced the plan of the work at the level of the ground of the place. The hall D is pierced by embrasures for 3 guns; a stairs is open to the middle of that hall and permits descent into the outworks C', whose plan is detailed at B.<sup>3</sup> The hall D is vaulted and open next the place, both to aid the defense and to allow the smoke to escape. The tower is furnished with a crenelated parapet with machicolations in form of inverted pyramids to facilitate firing downward and better protect the battery. On the platform is established a casemated battery with 4 embrasures, as indicated by the plan B. These embrasures





command the exterior over the crests of the merlons. A traverse in masonry protects men posted behind the parapet from enfilading and from the rear. The vaults of the battery and of the outwork are covered by stone dust and earth, beaten and turfed. The defensive system of this tower is easy to understand. The lower battery with the two guns sweeps the curtains, strikes the ditch and flanks the adjoining towers, with its gun it defends the counterscarp of the ditch opposite the dead point. The high battery protects the exterior; the outwork prevents the passage of the ditch; the battlements and machicolations protect the base of the work from near attacks and sap.

Note 3.115. The name of "moineau" is given to a small and low projecting work placed at the bottom of the ditch, defending it and able to contain musketeers or even crossbow men. (In Art. Boulevard see the great work of Schaffhausen, the circular defenses that fulfill exactly in the ditch the purpose of the moineau).

The uncertainty appearing in the defensive works of the second half of the 15<sup>th</sup> century is evident here. Men dared not entirely abandon the form and purpose of the old tower. During a siege they did not seek to break into a fortress by its towers, but by its curtains. The military architects of the 15<sup>th</sup> century had no other purpose than to appropriate the towers to the new engines, to make them thicker to resist the shots of the assailants and the vibration caused by the artillery that they must contain, to protect them from curved fire, and to give them a more efficient flanking. It was desired to retain for them a command of the exterior and even of the curtains, and in erecting them it was feared to expose them too much to the shots of the enemy. One feels that those parapets and machicolations were a weak defense against balls, easily overthrown much before the moment when most needed, and yet men felt unable to omit them, they had so much the habit of regarding this near defense as a serious protection. Yet these machicolations and battlements disappeared first in the strongly combined defenses about the end of the 16<sup>th</sup> century. The upper batteries, intended to prevent approaches, descended to the level of the ditch and became an outwork covering the bases of the towers. Fire in ricochet was not yet employed. The batteries of the besiegers could not destroy what they did not see; now the outwork being covered





by the counterscarp of the ditch, remained intact until the moment when the assailant prepared to cross the ditch to attack the scarp and towers. Thus it became an obstacle opposed to near attack, and remained standing when all the upper defenses had lost their crests. But already about the middle of the 15 th century, besieging armies carried with them bronze guns on carriages, which threw cast iron balls. <sup>1</sup> These projectiles being shot point blank against the towers, covered the outwork with fragments of stone and filled the space that separated the outworks from the defense, if they were ruined. Towers with short flankings and of small diameter became more injurious than useful; men thought of entirely suppressing them, at least to support them by new works arranged to receive artillery, independently of the earth ramparts built before the weak points. These new works belonged to the place. Built at a distance of half a cannon shot, they took the form of great cylindrical towers, receiving guns with long range on their tops to batter the exteriors and enfilade the fronts of ditches, being at their feet for a close defense and to send sweeping projectiles over the earth ramparts, that covered the salients or the gates. <sup>1</sup> Then at the end of the 15 th century the feudal castle could not have sufficient extent to defend itself efficiently against artillery. Cannon completed the ruin of feudalism. To resist the artillery required extended fronts; cities alone were suited to this kind of defenses. Extending the fronts, it was necessary to flank them. Men could at first provide for that necessity, indicated by the nature of things, only by means of earth ramparts established outside salients and gates, which ramparts crossed their fire; then as in all fortification, what defends must be defended, men found nothing better than to establish along old walls behind the ramparts great towers having sufficient height to command these ramparts and the outside over their parapets. The systems invented by the military engineers from the 16 th century until our days, are then in germ in the first experiments made at the end of the 15 th century in Italy, France and Germany. The Germans being especially conservators, still possessed intact examples of these works, a transition between the old system of fortification of the middle ages and the modern system. From this point of view, Nuremberg is the most interesting city to study.



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Note 1.p.117. Too late a date is generally given to the invention of the cast iron ball. Already about 1430 French and German artillery used them. The inventories of the artillery of Charles VII make mention of them. Vignettes of manuscripts of 1430 to 1440 represent iron projectiles. At the museum of artillery exists a bronze cannon of 1423 brought from the island of Rhodes, cast in Germany, that could only be used to throw cast iron balls. At the defense of Orleans in 1428, the artilleryists of Orleans had cast iron balls.

Note 1.p.118. Later Castriot (1584) adopted anew round towers in the middle of bastions, separate and in the middle of curtains. Vauban himself in his last manner (1698) established bastioned towers forming terraces separately between bastions intrenched in permanent fashion and the body of the place, a sort of forts that must inevitably delay the surrender of the place, since the fall of the bastion not only did not lead to that of the adjacent defenses, but required considerable works to take the bastioned tower forming a salient flanking. Montal-embert (1776) also placed separate "caponnieres" (rifle-pits) built of masonry in several stories at the rears of bastions, which are nothing but casemated towers having a considerable command over the outside. At the base the rifle-pit of Montal-embert is surrounded by a series of projections, forming in plan a series of star point projections, flanking each other, for pos ing riflemen. The Germans in our days have returned to towers having a command over the works. But in the presence of the destructive effects of the new artillery, this system cannot be of great value, unless one can face these casemated towers with a shell sufficiently strong to resist projectiles. These experiments repeated constantly since the middle ages only prove that the command of the exterior is always regarded as necessary, and that the fortification of the middle ages (in regard to the means of attack) had an advantage over our own.

The general plan of Nuremberg takes the form of a trapezium with rounded angles, with a culminating point near one of the angles, occupied by an old castle. A double enclosure of the 14 th and 15 th centuries with square flanking towers and wide external moat filled with water and with counterscarp, entirely surrounds the city, its width being crossed by a river. Albert Dürer erected a great tower at each angle, and a fifth one near





the castle on the highest point of the city. Gates are opened in the vicinity of the four towers, which are protected by advanced works. From the tops of each of the five towers are seen the other four. Those of the enclosure protect the salients, flank two fronts, command the gates, enfilade the lists between the two enclosures, and observe the country over the outworks of the gates. These towers are about 66 ft. diameter at 16.4 ft. above the ground, are built battering in courses of hard sandstone with bosses below and near the top. In the ground story they have a vaulted chamber, but drawn in such a way as to leave to the masonry a considerable thickness from the exterior. (See plan, Fig. 36).<sup>1</sup> The interior of the city is at A' at B are the lists between the gate of the outer enclosure and that C of the internal enclosure; the postern D permits one to descend into the ditch. At a is placed a wide machicolation that defends the entrance into the lower hall, and at b is a square opening in the vault, placing the likewise vaulted second story in communication with this ground story. One ascends to the upper platform only by a stairs made in the thickness of the wall and starting from the level of the defensive galleries of the curtains. At d are two chambers with embrasures for guns. Fig. 37 gives the perspective view of this tower.<sup>2</sup> The outworks date from the 15<sup>th</sup> century; in this work Albert Dürer built only the tower of the gate connected with it. The room in the second story was intended to lodge the post, for it had no embrasures. Its thick vault bears the circular upper platform surrounded by a protection of great timbers with openings for cannon with shutters.<sup>1</sup> A covering also of carpentry receives the conical roof, formerly surmounted by a watch-tower.<sup>2</sup> At A we have traced the profile of that upper platform.

Note 1.p.119. This tower is the one that commands Gate Loufer.

Note 2.p.119. The five towers are built on the same model.

Note 1.p.120. Article Creneau, Fig. 19.

Note 2.p.120. Excepting these watch-towers, the towers of Remberé are intact. The watch-towers are indicated in old engravings.

These elevated commands were rarely adopted in France after the end of the 15<sup>th</sup> century. French engineers rather sought to enlarge the parts, to extend the field of fire, rather than





to obtain a considerable command. They preferred barbette batteries to those covered batteries where the service was obstructed and men were suffocated by the smoke, as between the decks of a man of war. Besides, assuming these towers to be battered by artillery, even at a great distance, the convergent fire of the enemy must quickly destroy those timber protections, that like the bulwarks of great vessels, do not have the advantage of mobility given by the sea, and serve as points to aim at. However long the range of the pieces placed in battery on the platform, these guns could oppose only a divergent fire to the artillery of the besiegers, receiving ten projectiles for one that they sent. <sup>1</sup>

Note 1.p.121. In our time the famous Malakoff tower, that was an elevated commanding work, was destroyed first in the siege, and the resistance of that point depended on the earth-works constructed around the primary defense.

Yet some attempts of this kind were made on this side of the Rhine, but the French towers of the beginning of the 16<sup>th</sup> century had a greater diameter, less height and were crowned by barbette batteries with gabions or caponnières, like that presented in the preceding example. Most frequently these were made actual flanking towers, i.e., they were given a horseshoe form in horizontal plan, and their upper batteries scarcely exceeded the level of the crest of the curtains. (Fig. 38).

Yet there is always an advantage for the besieged in obtaining elevated command, or at least watch-towers permitting the discovery afar the works of approach of the besiegers, to establish on the entrenched bastions forts in horseshoe form on the ditch, so as to make difficult the occupation of the bastion. This need explains why were maintained so late the old towers of places of the middle ages behind bastions or half-moons; why Vauban in his third manner attempted to return to those towers dominating the bastions, and also why Montalembert made of these dominant towers one of the principles of his defensive system. In our days and since the marvellous progress of artillery, the question is proposed anew, how these towers can serve as traverses to protect the defenders from shots on the flank, and defy the effects of ricochet fire. The difficulty is to cover these towers with a facing capable of resisting modern projectiles, for however thick their masonry, it would



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soon be destroyed by the great shells of our artillery, and one of those projectiles penetrating . casemate would cause such disorder there, that the defense would become impossible. It is not alone the covering that is necessary to find, but also for the embrasures a shield that entirely stops the enemy's projectiles, while allowing the guns to be aimed.

There exists a nearly intact example of the defensive system of the transition, or of the use of towers (not old towers retained), but towers built to receive artillery) enters into the general plan of a strong place according to a systematic principle; the place is Salces, commenced in 1497 and terminated about 1503, under the direction of an engineer named Ramirez.

Near Perpignan, the place of Salces is situated between the pond of Leucate and the mountains; thus it commands the passage from Roussillon to Catalonia. Built with great care, it consists of a parallelogram flanked at the angles by four towers. Two half-moons cover two of the fronts. A keep occupies the third, and a half-moon forms a salient at one angle. The works are casemated; the towers and half-moons are crowned by platforms to receive artillery. Small pieces were also placed in a battery in the lower stories of the towers to enfilade the ditches. The works designated as half-moons are actual isolated flanking towers, open at the rear and joined to the casemates by caponnières or covered galleries pierced with loopholes for musketry. <sup>1</sup> A ditch about 49.2 ft. wide by 23.0 ft. deep encloses the entire castle. This ditch can be filled with water to the level of the court of the castle and even higher, and is placed in communication with the castle by narrow posterns. Further, other exits opened in the counterscarp really open into the outside, for in the legend added to the plan of the castle of Salces given by chevalier du Beaulieu, <sup>2</sup> is read:-- "There are more barracks underground in the castle; for it is casemated and countermined everywhere, and one passes under the moats to go outside." Men certainly did not pass beneath cunette of the inundated ditches, but at the bottom of the ditch, in the casemated galleries that communicated with a covered way made behind the counterscarp; a covered way to which one finds again certain galleries excavated on the ditch and thence outside, protected by advanced earthworks.

Note 1.p.123. See La Monographie du chateau de Salces, by C





Capt. Rotheau (Paris. 1860. Tona). This study of that old place is very well done and gives the most complete idea of it.

Note 2.p.123. Plans et profiles des principales villes et lieux considerables de la principaute de Catalogne. Paris. 168--.

But what gives to the study of towers of the castle of Salces a marked interest, is the manner in which they are arranged to shelter the defenders. In fact, except the road between the pond of Reucate and the last piers of Cochieres, the paleo of Salces is dominated by these heights. The towers, curtains and half-moons are subject to sight from the rear and enfilading.

By raising the parapets of the towers on the dangerous side and by establishing "parados" opposite the rears of the opposite towers, the engineer covered the platforms. Raising the parapets at the side next the mountain placed the embrasures under cover, while those on the opposite side are open to the sky.

Fig. 39 presents a birdseye perspective of one of these towers. One sees at A the elevated parapet protecting the gunners and pieces placed on the platform, just as would do a cavalier or traverse. The curtains are only built for musketry and are not furnished with embrasures, but have a parapet B and elevate those opposite the higher ground that look on the castle. Watch-towers C occupy the reentrant angles between the towers and curtains, and can receive musketeers, whose fire flanks the scarps. Further, small cannon placed in the vaulted and sufficiently ventilated stories enfilade the ditches and about the tops and batter of those towers.

Fig. 40 gives the perspective of one of the half-moons with its raised parapet at E to cover the platform from the enfilading views from the neighboring heights. In that Fig. will be observed the projecting beak, that reinforces the half-moon in front, and that covers a part of the dead angle by which the besieger could profit, for these half-moons are incompletely flanked by the angle towers.

The platforms are not sufficiently spacious to be able to equip all the embrasures with large cannon. The engineer either counted only on placing falconets in battery or on changing the places of the guns at need.

"Great precautions are taken against mining," says Capt. Rotheau; "a gallery extends along the four curtains before the





cellars, and at certain distances are ingeniously arranged short listening galleries."

TOURS REDUIT tenant lieu de donjons ou dependant de donjons.

Fortress Towers taking the places of Keeps or dependant on Keeps.

The oldest keeps are scarcely more than great towers near one of the fronts of the feudal castles, commanding the outside on the side that can be attacked and all the works of the fortress, with a special exit to the outside and a gate opening into the court of the castle. (Arts. Architecture Militaire; Chateau; Donjon). But certain strong places possessed forts, that must rather be regarded as dominant and independent towers than as keeps. Then about the end of the 13 th century the keeps became actual residences enclosing the services suitable for a habitation, and often reinforced by formidable towers that command the exterior, protect these lodgings and at need are forts able to hold out, if the keep were partly ruined by mining or fire.

There are still seen at Compeigne the ruins of a great tower of the beginning of the 12 th century, near the old bridge over which passed Joan of Arc on the day that she was taken by the English, and which is one of those works serving as a fort beside an enclosure. At Villeneuve-sur-Yonne, there also exists on the front opposite the river a great cylindrical independent tower, which served as a fort and commanded the country. This tower belongs to the 13 th century. The castle of Carcassonne possesses on the front facing the exterior on the side of the barbican and the Aude, two towers on rectangular plans and near together, that take the place of a keep; these towers date from the 12 th century and were raised at the end of the 13 th. (Art. Architecture Militaire, Figs. 12, 13). The palace of the Popes at Avignon, properly speaking, possesses no keep, but several fortress towers, that command the exterior of the fortress, and that date from the 14 th century. It is then necessary to distinguish in this Article fortress towers belonging to castles from towers belonging to keeps. We shall first occupy ourselves with the former.

It is again necessary to resort to the walls of the city of Carcassonne to find the most characteristic examples of these towers, a sort of keeps supporting a front. Along the first enclosure of this city toward the southeast exists a great cyl -





cylindrical tower, almost entirely detached from that enclosure, and that is named tower of the Vade or of the Papegay.<sup>1</sup> It is built on a salient and opposite the highest part of the plateau, which on that side faces the ramparts. Its base is flanked by a redan of the curtain and by the tower that we have given in this Article.<sup>2</sup> It dominates afar the vicinity, is entirely closed and was commanded only by the tower, that behind it belongs to the inner enclosure. It contains five stories, of which three are vaulted. In case of war, its upper battlements were equipped with wooden galleries.<sup>3</sup> The floor of the lower story is a little above the level of the bottom of the ditch. This lower story possesses a well.

Note 1.p.126. Art Architecture militaire, Fig. 11. It is the tower marked O on the plan.

Note 2.p.126. Tour de la Peyre, Figs. 13, 14, 15, 16, 17.

Note 3.p.126. This tower depends on the wall built under the reign of S. Louis.

We give the plans of this tower in Fig. 14.

The story A is in the ground story for the military road of the lists L between the two walls of the city. The covered way of the curtains of the external enclosure is at c, the ditch being at f. From the military road one ascends to the covered way by a flight d of a dozen steps, then finds himself before the only door e of the tower, that admits to the vaulted hall S. By taking the stairs f, he descends to the lower story B, likewise vaulted. This stairs ends at g'. A recess from g' to g permits hoisting by a windlass water or provisions to the level of the floor of the ground story. The well is at p. This cellar is only lighted by two elevated air holes i. From the hall S of the ground story, one takes the stairs k, ascending to the hall S, landing at l. That hall S is vaulted, has a fireplace m and is lighted by four slots and an elevated opening. From this hall S' by taking the stairs n one ascends to the third story S'' covered by a floor; this stairs lands at a. Resuming the stairs q he reaches the upper batteries. This third story has 4 windows and privies at t. It will be noted that the hall S of the ground story is pierced by 7 slots, that enfilade the crest of the counterscarp of the ditch. If we make a section a b, and we take the part of this section next the lists, we obtain the section in Fig. 42, a section that permits



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account to be taken of all the exits of these stairs. The level of the bottom of the ditch is at N and the level of the battlements of the curtains is at B. At E is traced the plan of the upper battlements, their floor being reached by the stairs h. Wooden galleries were placed all around these battlements, as we have partially indicated at V V". By the windows r r (see at D, Fig. 14) the post enclosed within the tower saw the upper parts of the inner wall and communicated or received orders. Thirty men could easily lodge in this tower, could store provisions there for a long time, have water and cook. Thus it was a fort still defending itself if the outer wall fell into the power of the besiegers. The sole narrow entrance was barricaded and closed by heavy bars.

The tower du Tresau of the same city of Carcassonne is also a fort, attached to the inner wall and depending on the works due to Philip the Bold. We give that beautiful tower in Art. Construction, Figs. 149, 150, 151, 152, 153, 154.

The tower du Tresau greatly dominates the curtains, and further has two watch-towers, that allow to be seen the entire vicinity of the city on that side, the castle, the tower of the western angle to the opposite salient, and the entire north front. (See plan of the city, Art. Architecture militaire, Fig. 11.<sup>1</sup>)

Note 1.p.128. The tower du Tresau is marked M on that plan. (Also see Art. Porte, Fig. 18).

It would be superfluous to furnish a great number of examples of these towers, which differ from closed flanking towers only by their relatively greater height and diameter. The well defended walls always possessed a certain number of tower forts more or less important because of their extent; some enclosures of an unimportant extent sometimes possess but a single one. Such is the enclosure of Villeneuve-sur-Yonne. This tower then replaced the castle and was surrounded by a curtain wall. Towers dependent on castles and taking the place of keeps, on the contrary like the keeps themselves, present a great variety of forms. Some are independent, can be isolated at need, possess a curtain wall, have their doorways elevated above the external ground; others are like the fort of the keep and are attached to it by a point; they are to the keep what that is to the castle. There should not be lost from view the true function of the keep, which is the habitation of the lord; now it is very





rare to find keeps, like those of the Louvre and of Coucy, that do not consist of a great tower without additions. We see that the Norman keeps, for example those of Berry and of Poitou, habitually consist until the 13<sup>th</sup> century, of a great rectangular residence divided into two halls in each story. This keep was always the habitation of the lord. The keeps of the Louvre and of Coucy are exceptions, and only served as the feudal habitation in time of war. (Art. Donjon).

In all castles of some importance, there is a stronger portion, whose walls are thicker, and that dominates the other works; the part that is really the keep. Either this keep is reinforced by a higher and stronger tower than the flanking towers; or indeed beside the part of the castle particularly reserved for the habitation of the lord is an isolated tower that in case of siege becomes the fort into which the lord retires with his faithful men, his family and his most precious possessions. Shut within this tower, he surveys the outside (for these works are erected on the most accessible point); it contains its garrison, and can sustain a second siege when the castle proper is taken. If the castle does not occupy a sufficiently large surface of ground suitable to receive the buildings for the garrison, a court, a residence for the lord or a complete keep, if it had a small extent, in ordinary times the lord and his attendants occupied the habitation; in time of war he called the liegemen who owed him military service, recruited and paid soldiers, and he with his relatives retired into the strongest tower, which thus became the keep. We find the very evident trace of this custom until the 14<sup>th</sup> century in the strong places of Guienne, interesting though small. Earlier in the castles of Isle-de-France of mediocre extent, we can likewise recognize that arrangement. Scarcely do the effaced characteristics of our century permit us to understand the life in time of war of a land possessing important fiefs and a beautiful and grand feudal habitation; but how far are we from representing to ourselves accurately the moral and physical energy of those castellans possessing fortresses of little extent, and in which however they did not hesitate at need to defend themselves against neighbors ten times more powerful. In these contracted places, the castellan was surrounded by a small number of vassals on whose fidelity he could always rely, and shut himself





within the master tower, there provide for the outer defense, anticipate treason, and inspire enough fear and respect in the garrison that it would not be tempted to abandon him. Then (and this fact often occurred) the castellan and some faithful men, with bridges cut and portcullises lowered, doors and windows barricaded, defended themselves to extremity, until the provisions failed.

this system of a fort, suited for an extreme defense, is adopted in an absolute manner in the great ruined tower of the castle of Montepilloy near Senlis. At one side this tower looked on the bailey of the castle, at the other on the castle itself, which had little extent.<sup>1</sup> We speak here of the castle as it existed in the 12 th century before the additions made by Louis of Orleans.

Note 1.p.131. This castle belonged to the Valois and was partly rebuilt by Louis of Orleans, when the prince fortified his duchy during the illness of Charles VI. The castle of Montepilloy, located on a hill and commanding the road from Senlis to Crespy, served as a point of support for the armies of the parties, that maneuvered in that country during the wars of the 15 th and 16 th centuries. It was dismantled after the entry of Henry IV into Paris.

We give (Fig. 43) the plan of the second story of that tower at the level where opens the only postern giving entrance to the interior. At A is the door that allows one to descend by a vaulted stairs in the thickness of the cylinder to the lower story; at B is the door by a long stairs, also vaulted, that gives access to the third story at C, and to the chamber D of the portcullis of the machicolations of the postern. Continuing the ascent by the stairs, one reaches the fourth story. The postern P is then elevated above the external ground by the entire height of the ground story. It is reached only by a wooden footbridge easily destroyed. This postern was closed by a grille and portcullis, a machicolation and a barred door. A little room E sufficient to contain two men has an oblique slot, that enfilades the floor of the footbridge. That floor had a trap through which by a ladder one passed by the pier of the bridge to the defensive gallery of the curtain G. The space between this curtain and the tower then formed a sort of ditch.<sup>2</sup>

Note 1.p.131. Later Louis of Orleans caused a part of this





curtain to be destroyed, and built a curtain at F, which enclosed the new work.

The section made an a b (Fig. 44) shows at A the tower of Montepilloy as it existed in the 12 th century, and at B with the modifications made in the defenses in 1500, in the upper parts. At C is seen the section of the curtain, at P the section of the postern, and at D is that of the room of the portecullis and machicolation over that postern. It will be noted that the ground story is vaulted, as well as the story above, by means of pointed arches of rectangular section resting on five piers. This upper vaulted hall is divided by a floor, which is the third story. The third story is entered by the door I and remains as it was in the 12 th century, except that in the 15 th century its wall was cut away at one point to place there a screw stairs, intended to ascend to the fifth and the battlement story with machicolations. The height of the old tower did not exceed the level N. Then the galleries H gave a plunging fire outside the curtain, as indicated by the dotted line. This fourth story was intended for storage of projectiles and for the upper defense, made by a series of arches some remains of which are sunk in the masonry of 1500; arches that connected the upper hall with the defensive galleries. This defense appearing not to have a sufficient command, that story was raised on arches in 1500; it was vaulted at V, and on that vault was established a platform with parapet and machicolations M, whose plunging fire struck the foot of the scarp of the curtain as indicated by the dotted lines on that side. It is clear that the footbridge S that connected the tower with the castle could be removed easily. At A is represented the ladder that from the trap of that footbridge allowed one to descend behind the pier by the defensive gallery of the curtain.

Fig. 45 gives the development of the interior of the tower of Montepilloy from e to f (see plan, Fig. 43). The stairs, taken in the thickness of the cylindrical wall, are indicated by dotted lines. At A is the postern and at B above is the room of the portecullis and machicolations. At C is the arcade that from the upper gallery opened into the wooden gallery before the increased height in the 15 th century.

This construction is well made in regular courses of 1.05 ft. height, and the entire work would be intact if half the cylinder



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had not been blown up by a mine. Happily the part preserved is that presenting the greatest interest, in that it contains the stairs and postern. Naturally there was blown up the parts looking to the exterior, when it was desired to dismantle the castle.

When one visits the castle of Montepilloy, he understands why Louis of Orleans judged it necessary to raise the tower and terminate it by a platform.

Possessor of the duchy of Valois, claiming to make of that territory a vast military network suited to dominate Paris, it was important to have near Senlis on the road to the capital a point of observation, that could uncover the length of that road from its exit from Senlis to Crespy. Now he could not choose a better point of observation, which being occupied by a garrison on a hill, allowed the obstruction of passage to all armies leaving Senlis. This garrison further had the certainty of being supported by troops shut up in Crespy, Bethisy, Vez and Pierrefonds, if that army attempted to force a passage. The men from Montepilloy had no reason for anxiety, if cut off from their own castle, since they could fight in retreat to Crespy and even farther, defending foot by foot the road leading to the heart of Valois. But for those obstacles to be efficient, it was necessary to have time:— 1, to place themselves across the road or on its flanks, at the moment when an invading army left Senlis; 2, to warn by signals or messengers the garrisons of the castles of Crespy and of Bethisy, each located five miles from Montepilloy, so as to be supported on the flanks.

Now to make these military arrangements, it was of great importance to give to the tower of Montepilloy the height that we know.

It is necessary to consider that the heights of this sort of towers depended far more on their strategic location than on their proper defense. Men habitually consider too little the strategic arrangements in the fortresses of the middle ages. They are studied separately with more or less attention, but little account is taken of the support that they lend for defending a territory belonging to the lord, or to the lords allied for common defense, a fact presented. The frequency of struggles between castellans did not prevent them from uniting against an invader at a given moment; and this fact presented





itself notably at the journey of S. Louis in the valley of the Rhone to reach Aigues-Morts. That prince reduced the little fortresses which commanded the river, whose possessors all defended themselves against his army, although those castellans were perpetually at war with each other.

To speak of only one province that has preserved a great number of feudal remains, Valois, one will note that the military posts were arranged in view of a common defense at need, much before the sovereignty of Louis of Orleans, and that prince merely improved and completed an already strong strategic situation.

Valois was bounded on the northwest and north by the course of the Oise, Aisne and Vesle, on the southeast by the river Ourcq, at the south by the Marne. It was widely opened only on the side next Paris, at the southwest from Gesvres to Creil. Now the castle of Montepilloy is placed on guard between those two points on the road to Paris passing by Senlis; it was supported by the castle of Nanteuil-le-Hardouin on the road from Paris to Villars-Cotterets, and that connected with the castle of Gesvres on the Ourcq. This was the first line of defense covering the most open frontiers of the duchy. Behind was a second line of places resting on the Oise and following the little stream of Autonne; Verberie, Bethisy, Crespy, Vez, Villers-Cotterets, Ferte-Milen on the Ourcq, and Louvry beyond. Behind these two lines, Louis of Orleans established as a seignorial fortress the place of Pierrefonds in an excellent position. Isolated towers were erected or old castles were enlarged on the banks of the Aisne and of the Ourcq. The passage from Champagne into Valois between these two rivers was commanded by the castles of Ouchy on the Ourcq and of Braisne on the Vesle, covered by the forest of Daule.

At the north and outside Valois in Vermandois, Louis of Orleans had purchased and restored the place of Coucy, which covered the course of the Aisne. All these castles (except Coucy) were placed on communication by direct views of each other by means of those high towers or by intermediate posts. Thus for example, the castle of Pierrefonds was placed in communication by signals with that of Villers-Cotterets by the great tower of Realmont, whose ruins are still seen on the highest point of the forest of Villers-Cotterets.





The expeditions attempted by Louis of Orleans, and that had but mediocre success, did not prove the military talents of that prince, but it is certain that when he resolved to establish himself in Valois so as to make himself master of the power and dominate Paris, he must have turned to a skilful man, for those measures were taken with perfect knowledge of the localities and the eye of a strategist. Thus the first act of the duke of Burgundy after the assassination of the duke of Orleans was to send troops into Valois, to lay hands on that formidable network of strong places.

Thus one should not confuse the keep, properly so-called, or habitation of the lord, the last fort of the garrison, with those towers independent of those purposes, that were erected according to a strategic arrangement to establish communications between the different places in a province, and to furnish means for isolated garrisons to combine their efforts.

Feudalism in France and in England possessed this special military character; that which we see expressed in also a general manner in Germany and in Spain, unless it was by the Moors in the last country. It seems that with us these defensive arrangements in general must be more particularly due to the Normans, who at the time of their entrance on the soil of Gaul understood the necessity for combining defensive means to ensure their domination. So we see them lose the ground, when they have taken possession of a country; and of all conquests recorded since the Carlovingian epoch, those of the Normans were almost the only ones able to ensure a durable possession to the conquerors; we think that the French nobility profited by that instruction, and in spite of the feudal subdivision, understood early this law of solidarity among the possessors of a country. The unity to be later established by the monarchy was then in part prepared by a system of strategic defense of the ground, by provinces, valleys or water courses. Philip August appears to be the first that understood the importance of that fact, for we see him systematically break those lines or networks of fortresses, by always attacking in each system the one that is the key to all others, with the sagacity of a consummate captain. S. Louis continued the work of his grandfather in war as in politics.

When the English were in possession of Guienne, they pursued





with system this principle of defense, and all the castles that they erected in that province, independently of their particular strength, have a site chosen from the strategical point of view. We find in Burgundy the influence of the same idea. Perhaps no province presents a more marked system of combined defense. The water courses and passages are defended by a series of castles or posts, whose sites are marvellously selected, both for local defense as for the general defense against an invasion. These fortified points join hands as do our towers of aerial telegraphs; and the proof of this is, that most of these telegraphic posts in Burgundy are established on the ruins of the fortresses of the 13<sup>th</sup> and 14<sup>th</sup> centuries. Then considering the castles from this point of view, one understands the importance of towers that occupy us; they contribute a serious defense in themselves, and thus ensure so much the better the communication between the feudal garrisons and their common action. It was particularly important, that if one of these castles were taken by treason or by a sudden attack, devoted men could still hold out for some days or even some hours in these forts, from the tops of which it was easy to communicate by signals with the nearest fortress; for then the neighboring garrisons in their turn could invest the fallen place and put the aggressors in the most dangerous position. That frequently happened. In France the water courses have a considerable extent, and the basins are perfectly defined; there were necessarily established by even the shape of the ground long lines of connected fortresses, that marvellously prepared for unity of action at a given time. Those are the views that do not seem to have been sufficiently appreciated in the history of our country, and which will partly explain certain political phenomena, that are too frequently stated without seeking their different causes. But all our feudal history is to be written, and to do this will be well once for all to leave aside those commonplaces on the abuses of the feudal regime. It is very certain that we can possess a history of our country only when we cease to appreciate our part with the fixed ideas that interfere with our understanding it, the time when we shall know how to apply to that study the spirit of analysis and of method, that our time brings to the observation of natural phenomena, finally on the day when we shall comprehend, that history





is not a plea, but a faithful and impartial record, drawn up to inform the judges, not to incline their opinion toward one or the other system.

But let us leave these considerations, a little too general with regard to the object that occupies us, and return to our towers.

Among those towers of Burgundy whose purpose is very marked, i.e., which were both as forts at need and posts of observation, it is necessary to cite the tower of Montbard, from the top of which one perceived the tower of the little castle that dominated the village of Rougemont on the Brenne and the castle of Montfort, that by a series of posts placed Montbard in communication with the castle of Semur-en-Auxois on the Armançon.

Montbard was a very strong place; the castle occupied a broad and steep hill of Jurassic rock at the junction of three valleys. Of this castle remains only the enclosure and the great tower with 6 sides, which occupies the angle of that enclosure at the highest point, so that it looks directly on the exterior above steep rocks. Fig. 46 gives us the plan of that tower, which dates from the end of the 13th century. The ground story A consists of a hall into which one enters only by the door a, pierced at the level of the ground of the platform; at b and c are the two curtains. The angle d profits by a projection of the rock and contains the privies. A cellar is excavated in the rock below that hall; its opening is at e. The lower hall is lighted by two windows and has a slot on the exterior; it is cross vaulted, and is not in communication with the upper stories. One can enter the hall of the second story only by the defensive galleries of the curtains (see B). The angle g is covered by a stone slope; then from this level a cut-off corner corresponds to that at i. The side h is borne on the lower arch j. The hall of the second story is lighted by two windows looking on the exterior. A stairs is made in the thickness of the wall at the side of the terrace, and ascends to the third story entirely similar to the fourth, whose plan we give (see C). The fourth story possesses three windows and two closets k, that do not exist in the story beneath, because of the passage of the stairs. These rooms are vaulted like the ground story. A screw stairs ascends to the platform, whose plan we give in Fig. 47. This platform is defended by battlements





battlements, and on each face by machicolations and slots. <sup>1</sup> Fig. 43 gives the section of this work on the line o p. Pinnacles placed on the upper batteries cause the top of the tower to be recognized afar. The crown of the keep of Concy presents an analogous arrangement. <sup>2</sup> These pinnacles can further facilitate intelligence by signals, since a banner placed at the right of a certain pinnacle indicates a movement of the enemy, the arrangements made by the garrison, or the nature of the assistance expected.

Note 1.p.140. Art. Machicoulis, Figs. 6, 7.

Note 2.p.140. Many of these towers were crowned by pinnacles isolated from each other.

The door A of the lower story was masked by the terrace of the castle, whose level rose above its lintel. The defenders charged with the guard of the tower, posted in the upper stories, commanded the two curtains, and all the efforts of an assailant, that after he had obtained possession of the castle, would have sought to penetrate into the lower story of the tower, -- which was difficult, since its door was pierced in a reentrant angle, -- would have succeeded only to fall into a real mousetrap, since that story has no communication with the upper stories. Besides, a machicolation is placed directly over that door and makes access to it very dangerous. If from the exterior the assailants climbed by ladders the rocky peak on which the tower is built, succeeded in attaching miners to the foot of that tower, and penetrated into the hall of the ground story, -- an operation scarcely practicable, -- by that they were not masters of the work. Here the angular system is adopted for the plan of the tower, according to the method accepted about the end of the 13 th century for tower forts crowned by platforms, particularly in the southern provinces. This form suits itself better to the lodging of the men and to the arrangements for habitation than the circular form; it gave unassailable sides, and men counted on the passive strength of the salients to resist attacks. They were further flanked by upper watch-towers, or about the middle of the 14 th century were dominated by machicolations.

In 1318 archbishop Gilles Ascelin erected the great rectangular tower of the archiepiscopal palace of Narbonne. That work is a fort, at the same time that it commands the place of the





city, the quays of the old port, the principal streets and all the surroundings. Built at the acute angle formed by the residence buildings,<sup>1</sup> This tower contains four stories and a platform or place of arms, below the battlements and well sheltered from the wind, terrible in that province, and able to contain a considerable mass of projectiles. Three watch turrets at the summit of the tower flank the visible angles, and the fourth angle is engaged in the palace and contains the stairs crowned by a watch-tower.

Note 1.p.142. See plan of the archiepiscopal palace of Narbonne in Art. Palais, Figs. 11, 12 and 13.

Here (Fig. 49) are the plans of that tower, at A on the level of the external ground, and at B on the level of the second story. The story A is only a circular cellar vaulted by a hemispherical dome and receiving no light from the exterior. The second story is of octagonal form internally, and is defended by slots on each of the three faces seen from the outside. One will observe that the firing chambers of those slots are separated from the central hall, covered by a cloister vault. Above (Fig. 50) is built a rectangular hall intended for habitation (plan C). This hall was the only one possessing a fireplace. It was lighted by three windows and covered by a carpentry ceiling. The fifth story likewise presents a square hall, cross vaulted (plan D). Then on the vault is arranged the platform, whose plan is given in Fig. 51. The middle part directly over the vault is below the defensive gallery, whose parapet is not pierced by embrasures, but only by long slots. The flanking watch-towers possess three stories of slots. The defenders penetrate into the lower story by the doors a, pierced a little above the level of the place of arms, into the second story by the doors b, and reach the fourth story beneath the open sky by the openings d. From the screw stairs one reaches the place of arms by the door e, and the defensive gallery of the battlements by the door e. The defensive galleries extend at f around the watch-towers.

A section made on g h (Fig. 52) explains this interesting arrangement. At A is the hall intended for the habitation of the lord, all the other stories being arranged for defense. This tower possessed neither wooden galleries nor machicolations; it defended itself chiefly by its mass, composed of excellent ma-





masonry of hard stone from S. Lucie. The fronts were scarcely flanked by the watch-towers. So we think that in case of siege, wooden machicolations were placed above the parapet, or perhaps only over the watch-towers, in order to see and defend the base of the tower. This magnificent fort is a masterpiece of construction; the courses are regular in height and are selected in the heart of the stone and connected by excellent mortar. In that mass is neither rupture nor crack; it is a mass of homogeneous masonry. That palce of arms, placed at a level below that of the defensive gallery, served for several purposes. It was an excellent site for establishing machines with long range, mangonels or stone-throwers, a shelter for the defenders of a storehouse for projectiles.

About the same time, i.e., from 1320 to 1325, was erected at the castle of Curton in Guyenne a tower-fort, whose plan presents certain remarkable peculiarities. This castle was rather defended by its position and its double ditch than by its works; the principal tower alone had some importance.<sup>1</sup> This tower, whose plans are presented in Fig. 53, contained 5 stories and a dungeon, all covered by tunnel vaults. The single entrance b in the tower was made from the adjacent residence at the level of the third story A. By the screw stairs one descended to the lower story B pierced by two slots. By a trap c he descended into the dungeon C, composed of two narrow rooms intersecting at right angles and containing a privy. The screw stairs ascended from the third story to the three upper rooms built on the same plan, and to the platform D equipped with a parapet and machicolations. The buttresses that abut the four angles have no function other than to afford flankings for the walls of the tower, and are sufficiently thick not to need these appendages. If one examines the general plan of the castle,<sup>2</sup> he will see that the angle G forms a salient that flanks (imperfectly, it is true) the adjacent watch-towers. This reinforcement with the salient still had the advantage of making the task of the miner much longer and more difficult. The tower of Curton further has a height of 103.3 ft. from the level of the floor of the dungeon to the upper platform, and the four buttresses strongly increase its area. In the same province should be mentioned the square tower of the castle of Lesparre, which was a fort crowned by a platform on a vault,<sup>3</sup> an actual post, for the area of the





castle outside the square tower is only 7535 sq. ft. Many of those castles of English Guienne of the 14 th century have but mediocre extent, and appear rather to be fortresses suited to guard the country than residences of lords, like our castles of the North. This is because the people of Gascony were not completely subjected to English domination, of which they had nothing to complain, but it was to protect Guienne from the almost continual attacks of the king of France, and these numerous little castles were well placed from the strategic point of view, commanding the the course of the Garonne and the mouths of the lateral valleys, and were more suitable to guard the provinces than would have been vast fortresses separated by great distances. Thus most of these little castles defended themselves by their location, some works of little importance and tower-forts, into which troops of armed men could retire and await in safety until relieved; from which they could sally and oversee the country.

Note 1.p.147. See Guienne militaire, by M. Leo Drouyn. Vol. II. p. 158 et seq.

Note 2.p.147. The same. Vol. II, p. 162. M. Leo Drouyn gives curious details of these little places, to which we request our readers to refer.

Note 3.p.147. The same. Plate 132.

In Normandy, where the English domination at the beginning of the 15 th century was contested by a large portion of the people, where it was necessary not only to protect the province against external, but also from those inside it, the rare fortifications erected by the English have an entirely different character. They tend to extend and reinforce important places, so as to have numerous garrisons centralized at certain strategic points. Thus the castle of Falaise, whose position was so important, was reinforced during the English domination, i.e., from 1418 to 1450, by a great cylindrical tower, that formed an addition to the Norman keep of the 12 th century (Fig. 54). The castle of Falaise covers an area of 3.7 acres; <sup>1</sup> the keep consists of connected rectangular buildings according to the Norman custom, was not high and did not sufficiently command the exterior; the English added to it the great tower A, called the Talbot tower, that contains 6 stories, including the dungeon and the attic. This great tower-fort is crowned by





machicolations with a defensive gallery. The upper battlements and the roof exist no longer since the religious wars of the 16<sup>th</sup> century. Several old square keeps of the Romanesque epoch were simply regarded as residences at the end of the 14<sup>th</sup> and beginning of the 15<sup>th</sup> centuries, residences that were reinforced by great annexed towers. This arrangement was the motive of a new programme at that epoch, followed in structures erected at a single spurt. Men set themselves to building keeps consisting of a spacious and habitable residence for the lord at all times, and flanked this habitation by strong and high towers commanding the exterior. According to that principle was conceived the keep of the castle of Pierrefonds.<sup>1</sup> Next the exterior this keep is actually protected by two great cylindrical towers with diameters of 50.9 ft. outside. These two towers are solid for the height of the batter, consequently being able to defy sap, and contain three stories intended for provisions and habitation, with an upper story of very important defenses, crowned by a double parapet.<sup>2</sup>

Note 1.p.149. Art Chateau, Fig. 7.

Note 1.p.150. Arts. Chateau, Fig. 24; Donjon, Figs. 41 to 44.

Note 2.p.150. These two towers were overthrown by mining. Their fragments in enormous masses lie on the ground; by the aid of these ruins, those works have been restored. The heights of the stories were further indicated by going on the remaining adjacent buildings.

Of the two towers, nearly similar in their internal arrangement, we give that of the angle, called tower of Charlemagne.<sup>3</sup> At the level of the court of the castle, it contains a vaulted cellar lighted by two slots (Fig. 55, 7). A passage B allows communication from the lower hall of the keep to that cellar. By the stairs C one ascends to the screw stairs, that serves all the stories of the watch-tower. At E is a pit made beneath the wardrobes adjoining this tower. Above the cellar A is a hall with segmental cross vault, that is on a level with the second story of the residence, and whose plan is similar to that of the hall G of the second story, which hall is likewise covered by a cross vault, and finds itself on a level with the third story of the residence. These hexagonal rooms are each lighted by three windows, having a fireplace K and a passage I communicating with the wardrobes M. At O is the court of the





provisions. <sup>4</sup> The stairs of the watch-tower N connects this passage N and consequently the hall G with the defensive gallery P of the wall guarding the court for provisions, that itself communicates with the upper defenses of the castle.

3.p.150. Each of the eight towers of the castle of Pierrefonds bears the name of the knight, whose statue is placed on the external surface. The statue of Charlemagne fills the niche at the top of the cylinder of the corner tower of the keep. (See *Notice sur le chateau imperiale de Pierrefonds*. 4<sup>th</sup> edition).

Note 4.p.150. Art. Donjon, Figs. 41, 42, 43.

Above this vaulted hall G is the story especially reserved for the defense, and whose plan we have drawn (Fig. 56). One ascends to that story by the screw stairs. A first door L gives access on the level to the area S posed on the vault of the hall of the third story. A second door pierced at the level of the upper revolution of the screw gives access to the defensive gallery R of the machicolations. Arches pierced in the cylindrical wall with steps like the seats of an amphitheatre, afford access from the defensive gallery R to the area S placed 9.3 ft. higher. The screw stairs allows one to reach over this hall a circular balcony with a view of the exterior by a great number of embrasures.

The section made on a b (Fig. 57) explains the importance of that story from the point of view of the defense. On the area A were collected the projectiles suitable for dropping through the machicolations round stones and boulders of all sizes up to 1.3 ft. diameter, since the holes in the machicolations are about 1.38 ft. That heap of projectiles at need could reach the level of the defensive gallery B, leaving an opening at the middle for the service and for the passage of men by the door C. The men serving the machicolations stood in the defensive gallery B, as well as the crossbow men. Laborers passed the projectiles to the men according to the orders given by the captain of the tower, who was posted on the balcony D next above. Thus by the openings, from the balcony the captain saw the entire exterior, and the men posted in the gallery and those charged with the projectiles did not have to seek the movements of the enemy, but only to execute the orders given to them. The crenellated upper story E was also manned by crossbow men charged with the dominant and distant fire. According as the besieger





100 came toward a point, the cap came toward a point, the captain caused projectiles to be accumulated at that point without causing confusion. If the assailant approached the batter of the tower, the men saw him through the holes of the machicolations, and only had to drop boulders to crush him. The fire through the open embrasures E could only be distant, or at most at an angle of  $60^{\circ}$ , because of the profile produced by the section of the gallery. The fire through the embrasures of the balcony D was either parabolic, or at an angle of  $30^{\circ}$  and  $60^{\circ}$ . It was the same for the fire of the cross-bow men posted on the defensive gallery B. Then by the machicolations was obtained a very plunging fire and the vertical fall of projectiles, which bouncing on the batter hit the assailants obliquely. Thus within a radius of 492 to 656 ft., the defenders could cover the ground with an innumerable number of bolts, arrows and stones. The summit of the watch-tower exceeded by several yards the top of the roof of the tower, and its screw stairs had an open newel to allow the watchman to cause the men posted in the defensive galleries to hear, just as if he spoke through a tube.

At G is traced the section through the middle of the sides of the internal hexagon, i.e., through the axes of the windows.

This is one of the last works slightly preceding the regular use of cannon, since the castle of Pierrefonds was terminated in 1407; thus those beautiful towers erected according to the old perfected defensive system were very soon reinforced by advanced earthworks suitable to receive cannon. At Pierrefonds as around other strong places at the beginning of the 15<sup>th</sup> century, one finds important and numerous traces of those advanced defenses built at the time when the besiegers brought cannon with them. The platform preceding these towers next the plateau is arranged to be able to place in battery mortars or culverins.

The celebrated tower of Montlhéry on the old road from Paris to Orleans, is both a fort-keep and a watch-tower. What is now termed the castle of Montlhéry is merely the keep, properly speaking, located at the highest point of the hill. The castle consisted of several enclosures arranged in terraces above each other, and containing buildings whose traces are scarcely discovered today. Each terrace was more than 100 ft. long, and only after having successively ascended all of them, one reached





the keep with the form of an elongated pentagon (Fig. 58). When one had ascended the terraces, he found himself before the entrance A of the keep, whose construction belongs to the first half of the 13<sup>th</sup> century.

Of the castle where Louis the Younger resided in 1144, there perhaps remain the substructures, but all the still visible portions of the keep, and notably the principal tower, fort and watch-tower, do not date earlier than 1220, although it generally passes for having been erected by Thibaut, forester of king Robert at the beginning of the 11<sup>th</sup> century.

This tower B is larger and higher than the four others that flank the keep, and had 32.3 ft. diameter above the pater: t the level of its platform was about 114.8 ft. above the sill of the doorway of the keep. Its plan presents a curious peculiarity. An elevated postern was closed by a portcullis and opens outside independently of the door opening in the court. Two stories were vaulted, the three upper ones being covered by floors. A series of corbels like those of the keep of Coucy received wooden galleries in two stories: a door also opened on the defensive gallery from the curtain c. This entrance passed through the hall of a screw stairs inscribed within a cylindrical turret, and left the level of this defensive gallery to reach all the upper stories. From the ground story one ascended to the second story by a stairs within the thickness of the wall next the inside. At D existed a quite large residence building, whose foundations alone are to be seen today. It is known what an important part was played by the castle of Montlhery during the middle ages.

This value was due more to its strategic position than to the strength of its works; and the great tower B of the keep was much more a point of observation than a defense. It is evident that for the garrison of Montlhery, the essential thing was to be warned in time, for thus it became impossible for the assailants to reach the elevated hill on which were placed the defenses: a few men sufficed to baffle a sudden attack.

#### TOURS DE GUET. Watch-Towers.

Castles and keeps had their watch-towers, and also cities. In the present state of Europe one cannot comprehend the importance of those elevated lookouts on the highest points of castles and cities.





If we have still retained the thieves that seek to enter by night houses in city and country, at least that guild only executes its projects by concealing themselves as best they can. But it was not so from the Roman empire until the 17 th century. During the administration of the last emperors, the villas and even the market towns were not always protected from bands of adventurers, who in broad daylight held to ransom private men and even little communes, as we still see done sometimes in Italy, Sicily, and on a part of the territory of Asia. Brigandage (to employ a term that only dates from the 15 th century) existed in a permanent condition under the Roman empire, even at the gates of the capital of the empire, and it is not equitable to carry back that institution only to the middle ages; it belongs somewhat to all times, and particularly to societies inclining toward dissolution. The feudal middle ages did not practise brigandage, and did not elevate to the height of an institution, as some feign to believe in order to demonstrate to us that the history of civilization only dates from the 16 th century.

On the contrary, feudalism undertook to destroy brigandage, which after the fall of the Roman empire passed into a custom, and extended itself at its ease over all western Europe. Feudalism was a true constabulary, an armed magistracy, and in spite of all abuses surrounding its reign, at least it had the advantage of arousing the people from the weakness into which they fell at the end of the empire and under the Merovingians. Those first possessors of lands, those vassals, knew how to group around their domains the terrified inhabitants of the country, and if the Roman colonists did not become citizens at once (an impossible task, since modern times have scarcely been able to accomplish it), at least they taught them by example to defend themselves and to unite at need under the shadow of the keep against the common enemy. That the castellans stole the great roads could be presented, particularly in the decline of feudalism; but it would also be unjust to make the feudal institution responsible for these crimes, just as it would be senseless to condemn institutions of credit, because one sometimes finds bankrupts among financiers. The Assizes of Jerusalem, that code elaborated by feudalism out of whole cloth, for the state of society of the time, is a collection of very wise ord-





ordinances, and that indicates a very correct appreciation of the conditions of the social order; and the barons, soldiers and civilians that edited that code, would have been greatly surprised if someone had told them, that an age like our own, which claims to enlighten all things, would regard them as robbers of pilgrims, toopers, pillagers without shame.

The watch-tower or turret is the visible sign of the system of armed police established by feudalism. The watch turrets of the castle have not only as their object to warn the garrison of a suspicious approach, but much rather to warn the people of the market town or village to suspect a surprise, and to caution them against a possible attack. It was not rare to see a troop of partisans profit by the hour when the men were in the fields to take possession of a market town and hold it to ransom. At the first alarm the castellan and his men had soon raised the drawbridge and sheltered themselves from insults; but these garrisons were very weak in ordinary times, and were unable to dislodge the troops of adventurers and prevent pillage of a market town; it was necessary to have time to collect the peasants in the country; for that purpose were erected watch-towers. At the first sound of the horn, at the first ringing from the belfry, the rural people assembled under the walls of the castle and organized the defense, relying on the garrison of the fortress. For the same motive, cities possessed watch-towers on points that viewed the country afar. These watch-towers established along the ramparts became the belfry of the city about the 14th century; beside the watchmen, they contained bells, whose ringing called the inhabitants to quarters designated in advance, where the local officers directed them according to the instructions transmitted to them by the military chiefs.

In the castles, the watch-towers not only served to prevent the danger of a surprise; the watchmen that were at the top night and day, warned the men of the castle of the return of the master, the hours of meals, the rising and setting of the sun, fires kindled in the country, the arrival of visitors, passengers and convoys. Thus the watch was the voice of the castle and its warning; hence the duty of watchmen was entrusted only to trusty and well paid men, for the work was hard.

Frequently the watch-towers were only watch-turrets, i.e.,





turrets on a principal tower and exceeding in height its top.<sup>1</sup> But there also exist actual watch-towers, devoted only to that purpose.

Note 1.p.157. Art. construction, Fig. 154; also Art. Echouette. The two outer towers of the keep of Pierrefonds each possessed a watch-turret. (See the preceding Fig.).

The city of Carcassonne possesses a very high one of an early epoch (end of 11 th century), entirely preserved. This tower belongs to the castle and dominates the entire city and the course of the Aude; it is built on a rectangular plan,<sup>1</sup> and contains only a wooden stairs with landings. Its top could be equipped with wooden galleries.<sup>2</sup>

Note 1.p.158. A legend claims that it saluted Charlemagne on his crossing to Carcassonne; but did Charlemagne ever pass by Carcassonne? Then the tower is only of the 11 th century.

Note 2.p.158. Art. Architectural militaire, Fig. 12, plan of the castle of Carcassonne (the watch-tower is at S); Fig. 13, a perspective view of this castle. Also see Archives des monuments historiques. Gide. editor.

The southwest angle of the Roman walls of the city of Autun, the culminating point of the enclosure, possesses a watch-tower of the 12 th century, of which we give a view (Fig. 69) taken outside the walls. This tower contains several rooms over each other and a wooden stairs. The twin windows of the upper room open on the side next the city. The crowning cornice forms a parapet, and gutter of the carpentry roof, with the defensive gallery. The water from this flat roof below the parapet is discharged by gargoyles.<sup>3</sup>

Note 3.p.158. This tower is now called the tower of Francis I.

The tower of Nesle at Paris on the left bank, and that controls the course of the Seine at its exit from the city, was rather a watch-tower than a work suited for defense. It was connected by a stockade with the tower on the right bank (called the tower forming the angle), that below the Louvre terminates the wall of the city. A lantern was suspended from its battlements to indicate to boatmen the entrance of the stockade that barred a large part of the river. From its platform was seen the wall on the west (left bank), the suburb of S. Germain, Pre-au-Clercs, the Louvre and the island.

The tower of Nesle was built under the reign of Philip Aug-





August at the same time as the wall of Paris, i.e., about 1200, and is designated in a document of 1210 "Torrella Philippi Hamelini supra Sequanam." <sup>4</sup> Only a century later was it known by the name of tower of Nesle. It was located at the place that the eastern pavilion of the Institute now occupies. On the quay near it opened the city gate called gate Nesle (see plan, Fig. 60), and at A extended a mansion of the same name. The tower of Nesle D of 32.0 ft. diameter had two vaulted stories and two stories with wooden ceilings, with a platform reached by a screw stairs E, after serving all the stories. These stairs rose above the level of the platform (that perhaps was primitively covered by a conical roof), and served as a watch-turret.

Note A.p.158. See Diss.archéol. sur les anc. encl. de Paris, by Bonnardot, Parisien. 1852. See the plans of Gomboust, and of Fer, Merion, the tapestry of the city hall, the engravings of Collot and of Israel Sylvestre, the drawings of Le Vou (Archives de l'empire). This tower was only demolished at the time when was commenced the palace des quatre Nations (the present Institute), about 1660.

The perspective view of this tower (Fig. 61), taken from outside the gate Nesle, <sup>1</sup> illustrates its value as a post of observation on the river. There could be transmitted signals to the Louvre and conversely, to the entire western front of the ramparts on the left bank <sup>2</sup> and to the palace on the island. Above Paris were two other towers that barred the river; one was called tower Barbeau and formed the head of the rampart on the right bank: the other was called the Tournelle and had the same purpose on the left bank. The two works were opposite the middle of the island S. Louis, and were connected with two other high towers built on the hills of that island, then intersected by a ditch filled by the Seine. <sup>3</sup>

Note 1.p.160. According to the documents cited above.

Note 2.p.160. These ramparts followed the direction of the present Rue Mozorine, that was built outside the city after the 16th century and was called Rue des fosses de Nesle, because it was built on the counterescarp of those ditches.

Note 3.p.160. Art. Architecture militaire, Fig. 18.

The tower of Villeneuve-lès-Avignon, built on the right bank of the Rhone at the end of the bridge of S. Benezet by Philip the Fair in 1307, as an observation tower at the same time as a





keep suitable for defense. It is connected with a vast system of fortifications that defended on that side the French territory against the encroachments of Provence,<sup>4</sup> and that later contributed to take from the Popes of Avignon all feudal rights over the course of the Rhone.

Note A.p.160. See in Art. Pont the history of the construction of this tower and Fig. 2.

This tower was built with four sides in lozenge plan, and possesses several vaulted halls and a square watch turret at top, with a turret also suitable to receive a sentinel. It is an admirably constructed work with platform, battlements with machicolations, and watch turrets at the angles. This kind of defense brings us to speak of towers regarded as isolated posts, a sort of permanent blockhouse.

TOURS-POSTES ISOLEES. TOURS DEFENSES DE PASSAGES, DE PONTS.

Isolated Tower-Posts. Defensive Towers of Passes and of Bridges.

The courses of our rivers, the passes of the mountains, certain lines of defense of a territory, yet allow to be seen traces of towers, habitually square, that served to ensure the tolls on the rivers and to repress brigandage, arrest invasions, and surprises by too powerful or turbulent neighbors. These towers are still found in great numbers in the passes of the Pyrenees, along the upper Loire, the Rhone, Saone, Aveyron and Tarn, Doubs and Isere, on the frontiers of Morvan, and in the Vosges, are located on high points and can correspond by means of signals. The selected site is habitually a steep point only connected with the adjacent heights by a tongue of land, so as to be accessible only at one point. This natural road is sometimes cut by a ditch or defended by a rampart serving as a curtain for the tower. One can enter the latter only by a door elevated above the ground, and by a ladder or a movable bridge resting on the defensive gallery of the curtain. A typical example will illustrate this arrangement frequently adopted in the passes of the Pyrenees (Fig. 62). Before the gate of the curtain was placed a barrier of wood. A machicolation defended this first gate. To penetrate into the tower-post one ascended a flight of steps leading to the defensive gallery of the curtain. This gallery extended to the side of the front of the tower in which was pierced the door. A movable bridge dropped





on a corbel on the defensive gallery by means of a windlass placed in the machicolation of the watch, and allowed one to enter this fort containing several stories and an upper platform intended for defense and for signals. These posts are often furnished with fireplaces and with an oven and a well reaching a spring, or with a cistern excavated in the rock and collecting rainwater from the platform and the area.

The Templar knights possesses many of these posts established on a great scale in Syria. "The various war stations possessed by the Christians in the middle ages in the hold land were connected together by little posts or elevated towers on a uniform plan; a great number still remain today, viz: - Bord-ez-Zara, Bordj-Maksour, Om-el-Maasch, Ain-el-Arab, Miar, Tokle, etc."<sup>1</sup>

Note 1. p. 162. See *Essai sur le dom. franc. en Syrie et l'Orient.* by G. E. Rey. 1866.

These tower-posts built by the knights of the Temple in Syria and the East are rectangular in plan. M. G. Rey, from whom we borrow the data concerning those of Syria, gives plans and a section of one of these towers, that of Tokle, that we reproduce here from him (Fig. 63). One enters the lower hall by the gate A. At the middle of this hall is excavated a cistern. To seek the door opening to the straight stairs ascending to the upper stories, it is necessary to reach the floor B by means of a ladder. A tunnel vault forms the second story and a cross vault without ribs supports that upper platform; a second floor divides this third story into two, to reserve a storeroom for provisions beneath the platform. A machicolation commands the door. The ground story could serve as a stable for several horses.

It is interesting to find at Paris a tower built by the knights of the Temple, and that presents an arrangement analogous to those found in Syria in the posts of that military order. This defense was placed opposite the existing Collège of France, and was known under the name of tower Bichat, because the celebrated professor gave his lectures there.<sup>1</sup> It belonged to the commandery of St. John of Jerusalem, which later in the 16th century took the name of St. John l'ateran. "The principal entrance of the commandery opened," says Baron de Guilhaemy,<sup>1</sup> "opposite the Collège of France. The most notable buildings in the enclosure were the tithe barn, the house of the commander,





the tower, church and cloister. We think that this tower was the keep of the commandery, the depository of documents, arms and precious articles, the place of assembly of the knights, the sign of the sovereignty of the commander over the fiefs belonging to S. John."

Note 1.p.164. It would have been easy to preserve this precious monument, that did not seriously interfere with the course of the new streets in this part of Paris. It was a very curious example of the works due to the Templars at about the end of the 12th century. In spite of the protests of the most authoritative persons, the demolition of tower Bichot was hastily decided, and we scarcely had time to measure that edifice. Some capitals from that demolition were transferred to the museum of Cluny, but this was not by its sculpture, although beautiful, that this edifice interested the historian.

Note 1.p.165. See the excellent *Itinéraire archéologique de Paris* by the learned author of so many precious works on our national antiquities. Like all those that have the same care for our historical monuments, M. de Guilhermy deplored in 1855 the destruction of the tower Bichot. "The city of Paris," said he, "that has made so many generous sacrifices to save the tower of S. Jacques la Boucherie, on the contrary showed itself for that of Lotron, and yet if the first enjoyed a greater fame, the other belonged to a better epoch of art, and was connected with a group of edifices of a more interesting character." We should add that the tower of Lotron was the only monument of the kind in France."

The tower of the commandery of S. John of Jerusalem, built on a rectangular plan, was joined to the residence of the commander by one of its angles; by another it was connected with the curtain. This commandery having been transformed at several times, it became difficult to recognize accurately what was the position of the tower in relation to the buildings of the same epoch. Yet Comboust's plan shows it as facing the outside on the western front, and in fact its principal defenses were presented on that side. Further, measurements made of it taught us more than could the documents furnished by the old plans of Paris. Here then at A (Fig. 64) is the plan of the ground story of the tower. This ground story consisted of a hall in two bays with cross vaults, with a low postern at that formerly opened on





the external ditches; a door b likewise opened on the stairs, and allowed one to reach the level of the court by passing over a movable bridge g, for the internal ditch f was extended by a redan to that stairs. D was then the ditch enclosing the commandery; f being the special ditch of the tower. The lower hall had no communication with the upper stories. To reach the second story B, it was necessary to ascend by the stairs C attached to the western curtain. This second story did not communicate with the house of the commander located at H; it was necessary to follow the stairs C to attain the level of the third story E. From that hall one could enter the commander's residence by the door e pierced in a cut-off angle. Also by the stairs C one ascended to the platform G, covered by a hip roof. That stairs C was of wood, enclosed in a structure with thin stone walls. From the house of the commander at the middle of the second story it communicated by a crenelated gallery I (see plan k) with the defensive gallery of the curtain. A longitudinal section made on m n will more clearly explain these arrangements (Fig. 65). A is the bottom of the ditch, whose counterscarp does not appear to have exceeded the level B. At C is found the door that gives entrance to the stairway. At D slots are pierced at the backs of three recesses made in the wall of the second story. At E is the crenelated passage communicating at the middle of the story from the house of the commander to the western curtain. The lower hall was lighted only by high air holes; as for the two vaulted halls above, numerous windows allowed the light to enter. The upper embrasures were closed by wooden shutters entering rebates. Fig. 66 presents the section through the hall of the second story on the side of the defense. Three niches are seen at the back of the hall. Before the middle one is placed a double column that supports the two discharging arches on which rests the upper wall. (See plan B and the longitudinal section). For one will note, that to give more stability to the construction and to support the pressures toward the interior, the walls recede inside to the side arches of the vaults. From the exterior of the commandery, the tower had a severe appearance. We give a view of it (Fig. 67) with the curtain, the enclosure of the stairs and a part of the residence of the commander.

This structure of small masonry was well treated and had





suffered no alterations other than those caused by the vicinity of modern structures abutting against its sides. The vaults of the halls were in good condition, and the restoration of this curious specimen of a tower of a commandery would have been neither difficult nor expensive.

The tower of the Temple at Paris dated from the end of the 13<sup>th</sup> century and was completed in 1306, a little before the dissolution of the orders.<sup>1</sup> This tower was on a square plan with four turrets at the angles ascending from the ground. It served as treasury for deposits and documents, and as prison, like most of these keeps belonging to the establishments of the knights of the Temple. This edifice was destroyed in 1805.

Note 1.p.170. Art. Temple.

We still possess at Paris one of those works serving as a retreat, treasury, place of safety, in mansions possessed by princes in the midst of cities; it is the tower still seen in Rue de Petit-Lion, and that belonged to the mansion of the dukes of Burgundy. "The edifice," says our learned friend Baron de Guilhermy,<sup>2</sup> "is solidly built of stone carefully dressed; it is pierced by pointed openings and crowned by machicolations. a broad screw stairs ascends to the upper story containing a beautiful hall with cross vault. The windows lighting the stairs are rectangular and are decorated by mouldings. The steps turn around a column, which terminates in a very simple capital; but this capital serves as a support for a cylindrical drum, from which spring vigorous stems representing oak branches, whose interlacings form the ribs of four groined vaults, and whose leaves are detached and project from the masonry fillings." A secret chamber is arranged at the top of the tower and can be isolated from the passages by means of a pivoted shutter.

Note 2.p.170. Itiner. archéol. de Paris. p. 279.

The tower was built by duke Jean-sans-peur (John the Fearless) in the first years of the 15<sup>th</sup> century. That prince inhabited this mansion when he caused the assassination of Louis of Orleans in Rue Barbette. The mansion of Jacques Coeur at Bourges also possessed its tower, fort and treasury, whose principal room on the level of the second story was closed by an iron door.<sup>3</sup>

Note 3.p.170. See Art. Maison, Pl. 4, the plan.

We cannot pass gate towers in silence. Frequently the secondary





gates or even posterns were pierced through the towers instead of being flanked by them. That arrangement scarcely appeared before the end of the 13<sup>th</sup> century, and it is pretty rare. Again in the city of Carcassonne do we find one of the most remarkable examples of this sort of works. On the south front of the second enclosure rises a high square tower with four turrets rising from the ground, that externally show no doorway, but at one of its sides (that on the east) opens a door or rather a wide postern, whose sill is placed 6.6 ft. above the external soil. Fig. 68 presents the plan of this tower at the level of the ground story. To reach the sill A it was necessary to place outside a ladder or inclined plane of wood. This first entrance is defended by a machicolation a, a portcullis b and doors c. Thus one enters beneath the vault pierced by a square opening at the centre; then it is necessary to turn to the right, and he finds himself before the second door, also defended by a machicolation d, a portcullis f and doors g. Passing this second door, he is in the city.<sup>1</sup> The curtains of the walls are at B and C. The two doors h and i open into a passage that communicates with a screw stairs ascending to the watch-turret l and to the upper stories. The second story (Fig. 69) shows at o the external machicolation, that is served over the portcullis p, when that is lowered; the second machicolation g and the second portcullis are served by the passage t. The hall of the second story contains a fireplace k with oven, three cupboards s, and a well v, that also has an opening on the lists. Two windows f light the room. The screw stairs ascends above this hall to a first battlement enclosing a second hall with tunnel vault, crowned by a platform suitable to receive a machine with long range.

Note 1.p.171. See the general plan of this city. This gate is that of S. Nozire. (Art. Architecture militaire, Fig. 11 et D).

Fig. 70 gives the appearance of the tower on the side next to the city.

One will observe that this tower interrupts the defensive gallery of the curtains, over which it also exerts a considerable command. A broad straight stairs placed on arches (see at E, Fig. 68) reaches the level of one of the defensive galleries a and ends opposite a door opening on the screw stairs. The slope of the ground inside inclining toward the entrance, a gargoyles





is pierced at G about 6.6 ft. above the ground of the lists, and at need this could serve as a speaking tube for the returning patrols. This work belongs to the defenses added to the city of Carcassonne by Philip the Bold, and is built like the tower of the bishop's palace on courses of hard sandstone with bosses, jointed with care. It dominates the barbican of the outer wall and the entire vicinity, for it is placed on the highest point of the plateau. Its mass serves to mask the church of S. Nazaire, only distant 32 pt. Its platform is covered by stone slabs, and a watch-turret H (Fig. 70) surmounts it, to allow the master engineer to direct the working of the great machine placed in battery on that platform.

Note 1.p.172. The stone-thrower is represented in battery on that platform.

Outside, the tower of the postern of S. Nazaire presents an appearance still more imposing, for the ground of the lists is 9.3 ft. below the sill of the second door. Fig. 71 shows this exterior next the side of the postern, the wooden galleries b being assumed set in place for the defense. These galleries are placed on but three sides of the tower, before the parapet of the defensive galleries, leaving the watch-turrets free and their slots; so that these turrets flank the wooden galleries and are arranged as indicated by the section (Fig. 71 bis).

According to custom, the communication between the ordinary defensive gallery A and the defensive gallery B for war consists in the embrasures pierced in the parapet. From this gallery B by the end of the miller's ladder the crossbow men ascended to the raised gallery C and could shoot bolts through the machicolation D. Three rows of crossbow men thus firing simultaneously. Further, projectiles were dropped vertically at need through the machicolations M.

Profiting by the command from the upper platform, a fourth row of crossbow men shot bolts afar through the openings with shutters and the slots pierced in the parapet. Dotted lines indicate the angles of fire.

Sometimes the arrangement of gate towers was adopted for sake of economy. It was less expensive to make an opening in the base of the tower, than to flank that opening by two towers according to the most general custom. Several of the blockhouses built in Guyenne under English domination have square towers





for gates. One finds even before that epoch in the country traces of gates pierced through square or rectangular works. Such is gate Branet at S. Emilion, whose construction is still entirely Romanesque, although it scarcely dates before the beginning of the 13<sup>th</sup> century. One of the gates of Cadillac offers a curious arrangement, among the works of that kind. It was only in 1315 that the enclosure of the blockhouse of Cadillac and its portals were commenced.<sup>1</sup> The inhabitants must erect the walls, and the lord of the place, Pierre de Grailly, the four good and sufficient portals. It seems that these four portals, the lord of Grailly built only two. Here is one of those, called gate Garonne, constructed with the greatest economy, but presenting an arrangement little known.

Note 1. p. 176. See Guyenne militaire, by M. Leo Drouyn. Vol. II. p. 255. Also see in the same work the gate of S. Mociere, called gate Cadillac, that is rectangular in plan and crowned by a simple row of machicolations.

Ditches about 77 ft. wide and filled with water from the Oeil-le surround the old fort. Gate Garonne projects its entire depth outside the curtain, whose defensive gallery continues behind it, and it sweeps the ditch. Here (Fig. 72) is the plan of that gate at the level of the ground story at A, and at B is on the level of the second story. In the last plan is seen at a the defensive gallery of the curtain, that the work does not interrupt. The machicolations and slots b are pierced 6.6 ft. above the floor of this defensive gallery, and consequently cannot be served by men posted in that gallery, but indeed by soldiers placed on a wooden floor seen at d in the longitudinal section (Fig. 73); now one can only reach that floor by passing through a door opened at e in the level of the second story (see plan B), and can only ascend to that floor by a movable ladder drawn at f (Fig. 73), and that starts from the floor of the gate. The guards of the door then have the sole charge of watching over its defense, and do not communicate with the defensive gallery of the curtains. Since according to the charter establishing the defenses of Cadillac, the inhabitants built the walls and the lord erected the gates, it might be that the guard of the latter was only confided to the men of the lord of Grailly. They alone could open the gates and alone could defend them. The lord would thus have less to fear the consequences of weak-





weakness, discouragement, or even negligence of the citizens, sufficiently disposed at all times not to brave the length of privations of a siege.

To have an understanding with enemies and aid them by means of passing a moat 66 ft. wide and filled with water, and to scale a rampart 33 ft. high, was an act of treason that brave men could not perform; but to allow the post of a gate to be surprised, or to listen to proposals, and consent to lower the drawbridge before a troop making fine promises, was what frequently happened to soldiers.

It seems that the builder of gate Garonne of Cadillac may have desired to avoid this danger by making this defense, in spite of its small importance, a post absolutely independent of the ramparts of the city. In our longitudinal section (Fig. 73) it is seen that the defensive gallery is easily overlooked by a man posted on the floor d. The place of the movable ladder allowing one to reach the door e (plan 72 B and section 73) is still perfectly visible. The pier p is wider than the pier g. Then the machicolations and slots commence only after the door e. (See transverse section, Fig. 74). The protecting wall of these slots is borne on two corbels and an arch, thus leaving a space between it and the side wall g; a space which the ladder fits. That was in two parts; a side and upper part was fixed, set on a rest arranged on the corbel beside the guard wall; the other followed the wall g to the ground. The second part of the ladder f (section, Fig. 73) slid at need on the timber i fastened to the wall, and on the other side l was held by the timber m resting on the corbel s. But the door e and the help of a rope, it was easy to slide the descending ladder on the sides of the fixed ladder. It is understood that a guide prevented that descending ladder from leaving its plane.

The men of the post having ascended the ladder, passed through the door e and descended by the little ladder to the special defensive gallery d. Thence through three slots they could shoot bolts at the first gate and serve the machicolations, if the enemy reached the gate barrier t. A small drawbridge v closed the first gate. The defensive gallery d was covered by a simple and very steep shed roof r. Also by the ladders one ascended to the second story of the upper defense, consisting of battlements and pierced by slots with machicolations on the front and





sides of the tower. If we assume that the section made from x to y (plan B) looking toward the interior of the tower, we obtain Fig. 75. This drawing shows us the arch of the door at e, the floor of the defensive gallery of the curtains for the service of the soldiers at b, and the defensive gallery of the post especially for the guard of the tower at a, with its door a c opening on the movable ladder. <sup>1</sup>

Note 1.p.180. The very complete drawings of this work have been furnished to us by M. Durand, architect at Bordeaux.

Still these square towers serving as gates do not appear to offer sufficient resistance to a determined assailant: their fronts were not flanked, and the serious defense commenced only in even the interior of the tower, when the outer gate was already taken. There was an inconvenience in that method. In the matter of fortifications, it has always been bad to reserve the most efficient means behind, for the troops are then disposed to abandon readily the external defenses to take refuge in those that they regard as stronger, but which are the last, and which thus arouse the energetic efforts of the assailants. A place encroached on as soon as taken, the besiegers becoming the more energetic and bold, when he has obtained a first advantage. It is an axiom of defense, that has never ceased to be applicable:— it is easier to prevent an assailant from advancing, than it is to drive him back when he has gained a post.

A gate not flanked, like that of the fort of Cadillac, was soon forced by filling the ditch. Then the besiegers found themselves in front of a second defense, it is true, relatively strong and well equipped; but it was easy for them to set fire to the floors of the tower by piling fascines under the passage, and in that case the work had no more value. At the end of the 14 th century however, the towers assumed new importance because of their command, <sup>1</sup> and a celebrated soldier, Olivier de Clisson, continued to employ them as gates. Yet Olivier de Clisson renounced the square plan and adopted the cylindrical form. The castle of Blain, situated between Redon and Nantes, was built at the end of the 14 th century by the constable Olivier de Clisson. The entrance gate of the bailey is placed in a round tower, called tower of the drawbridge, that still shows on the exterior and interior the crowned M with a helmet. This monogram is equivalent to a certain date, for one





finds it on the seal of Olivier de Clisson of 1407, and on the buildings of the mansion of the constable built in Paris about 1388, now comprised in the palace of the archives of the empire.<sup>2</sup> It is further known that about 1366, Olivier de Clisson, who had sworn never to have the English for neighbors, demolished the castle of Gavre that the duke of Brittany had just given to Jean Chandos, and he had the stones taken to Blain to use them in the construction of a new castle. Now it appears that the ferocious constable had adopted in the defenses that he erected, a system of gates passing through the cylinder of a round tower, with drawbridge, long passage, folding doors, machicolations and portcullises.<sup>3</sup>

Note 1.p.181. Thus we have explained concerning one of the towers of the castle of Vincennes. The gates of that castle are pierced in the tower on rectangular plan and analogous to that represented in Figs. 31, 32.

Note 2.p.181. Photo taken from an unpublished Note of M. Alfred Rome.

Note 3.p.181. On this programme was constructed the gate of the bailey of the castle of Blain just mentioned.

The round tower had this advantage over the square tower, that it threw divergent projectiles, left no dead points under the machicolations, and was difficult to attack by mining.

These gate towers of Olivier de Clisson had a considerable command over the curtains. That of Blain is covered by a conical roof, and over the vaulted passage of the gate is a square hall with fireplace, closets and a stairs ascending to the defensive galleries of the machicolations.

The celebrated castle of Montargis possessed a gate tower constructed nearly according to this programme, but developed. We present its plans (Fig. 76).<sup>1</sup> At A is traced the plan of the ground story. A drawbridge was lowered at a on a road; b was a wide ditch; d, the isolated curtain of the tower; e, the great hall with battlements;<sup>2</sup> f, the second drawbridge, so that the tower could be entirely isolated from the outside and from the court g of the castle.

Note 1.p.182. See Du Cerceau, *Les plus excellents bastiments de France*.

Note 2.p.182. Article Holle.

When one had passed the first gate a, he found himself in a





cylindrical court, a sort of well open to the sky with no exit other than the gate *f* of the court. In the second story *B* the tower communicated with the curtain by means of a wooden foot-bridge landing at a little post *h*. By two passages reserved in the thickness of the cylinder one reached the two rooms of the portcullises, and found opposite the foot-bridge a screw stairs ascending to the upper story of the defense, whose plan is represented at *C*. That story consisted only of an annular gallery with battlements outside and inside, so as to allow the defenders to crush the assailants that had ventured into the circular court.

From the ground one could not ascend to the upper stories. Small posts were probably arranged in the thickness of the cylinder between the rooms of the portcullises and the crowning gallery. Fig. 77 presents the section of this tower, made on the axes of the gates *a* *A*, and the detail of the upper gallery at *B*. We cannot state whether this work was earlier or later than the defenses built in the West under the orders of the constable de Clisson; but it is certain that it belonged to the same order of defenses.

We have shown in Art. Pont towers intended to defend passage; some are square, like those of the bridge of Cahors; others are circular or elliptical, like the great tower of the bridge of Saintes. It is then useless to extend farther here on these towers set across passages. It remains for us to say some words on light-towers. One of the oldest is the tower of Aigues-Mortes, called the tower of Constance, built by St. Louis. This cylindrical tower has 91.9 ft. height by 72.2 ft. diameter; a turret of 36 ft. rises on the platform near the battlements, and supports the night fire intended to guide the ships entering the port. That platform is arranged to receive the rainwater, which runs into a cistern. Two vaulted halls are constructed below the battlements and are only lighted by slots.

On the square tower of fort St. Jean, that flanks the left side of the entrance of the old port of Marseilles, and that dates from the 14th century, formerly existed a turret supporting a fire. On the shores of the Mediterranean, in the suburbs of Aigues-Mortes, are still seen traces of isolated towers, that served both for light-towers and for posts to defend the shore against the descents of pirates.





Most of these works date from the reigns of S. Louis, Philip the Bold and Charles VI.

The destructive climate of the coasts of the ocean has not allowed the light-towers of a remote epoch to remain, and one can regard as one of the earliest the tower of the port of Rochelle, called tower of the lantern. That work is attached to the ramparts and rises on the shore of the sea at about 325 ft. from the mouth of the harbor, at the end of the left front. It is a great tower 52.5 ft. diameter, terminated by a pyramidal stone spire.

We give the plans (Fig. 78) of its three stories, at A being the ground story, at B on the level of the second, and at C on the level of the defensive gallery.<sup>1</sup> The lower story is vaulted; it communicates with the city by the passage a, but is not connected with the upper stories by any stairs. The second story is only entered by the passage b opening on the defensive gallery of the curtain. From that passage one ascends by a screw stairs to the defensive gallery of the tower with battlements at C; then at this level is found a second stairs h reaching the lantern attached to the spire. Fig. 79 represents the section of the tower. One notes that the defensive gallery is pierced by machicolations. At A is the lantern that receives the fire, which was masked by the spire from certain points of the horizon. It is true that the lantern is at the side next the high sea, and that its fire illuminated the point of the spire, which might be for sailors a means for not confusing this light-tower with another. The construction of this tower dates from the end of the 14<sup>th</sup> century. Fig. 80 presents its elevation on the side next the entrance of the harbor. A balcony is reached by the screw stairs, is placed at the mid-height of the stone spire, and permitted the placing of watchmen or even additional fires.

Note 1.p.184. M. Lisch, architect, who has written a very remarkable work on the port of Rochelle, had the courtesy to permit us to reproduce his drawings of the tower of the lantern.

It has been recognized in our days, that it could not suffice to place lighthouses at the entrance of roadsteads or of rivers to indicate the passage to mariners, but that it is first important to mark the position of the coast. "Now this coast presents a series of capes variously accented, that may be regarded as





the apexes of a polygon enclosing all the reefs; and men have placed a light on each of these so as to indicate the land as far as permitted by the height and the power of the apparatus. They have further established such a relation between the distances between the points and the reach of the lights, that it would be impossible to approach the coast without having at least one light in sight, while the air is not foggy." <sup>1</sup> One will understand that to execute a work of that nature and according to that method, it is first of all essential to have very accurate maps of the coast. Now topographical science is an entirely modern science.

Note 1.p.127. *Memoire sur l'eclairage et le balisage des cotes de France, 1864*, by M. Leonce Reynoud.

Coasts during the middle ages, as well as during the period of Grecian and Roman antiquity were recognized only in an imperfect manner, yet sufficiently that reefs or promontories may have been marked by towers or simple furnaces in which were burned resinous materials during the night.

If one traverses the coasts of France, particularly in Normandy and on the Mediterranean, it is very rare that in the vicinity of modern lighthouses, he does not find traces of structures of the middle ages. During that period as during antiquity, if men communicated by means of signals placed on elevated points while the day lasted, at night fires became a habitual means of communication between distant points, as still practised in the mountains of Switzerland and the Cevennes before the establishment of the electric telegraphs. It is unnecessary to say that these lighthouses supported, either simple gratings of for resin, or permanent fires enclosed in lanterns, and that they could not have the range of our modern apparatus.

The extent that we have been compelled to give this Article sufficiently shows how important were structures with great command in the architecture of the middle ages. This desire or need to erect towers exists in all civilizations, that have not reached complete development. Those that built wished to see and be seen afar. Thus the tower became also a security, a means of oversight and a mark of honor.

Under the feudal system, the lords alone had the right to erect towers; vassals could not possess them. (Arts. Chateau; Manoir.





It is well understood that abbots exercised the same right, as feudal lords, which both for lay as well as religious lords was subject to authorization by a sovereign. Thus under Philip August and under S. Louis, many a lord was compelled to demolish the towers, that he had built without first having obtained t the royal sanction.

Demolition of towers ordered by the sovereign was almost always caused by the complaints of the neighbors. Notably the abbots and bishops carefully saw that castles with towers were not erected in their vicinity. Their complaints on this subject are frequent, and when the parties could not agree, it was necessary to resort to the royal authority. Was tha always expected? This is doubtful; hence between the lords the conflicts that in the end caused the royal intervention to the detriment of one of the two adversaries, sometimes of both, and to the benefit of the sovereign power. Besides in case of war or defense of the territory, the king had the right to occupy, or c cause to be occupied by his troops, the castles, towers and ke keeps of his vassals.

Now in spite of this right, it sometimes occurred that the gates of castles remained closed before their sovereign, who was not always in condition to cause them to be opened by force. Thus castles and their formidable towers became for royalty, as they were strengthened, a memorial of insults frequently unpunished. Louis XI struck the first blow at these feudal nests. The Renaissance, even more by feshion than by politics, saw a great number destroyeda Henry IV, Richelieu and Mazarin dismantled the last.

Yet such was their number on French territory, that we find many of these defenses and posts still standing.

#### TOURELLE. Turret. Small Tower.

Diminutive of tower, a small tower or rather a tower of small diameter. Manor houses could not have towers, but only turrets. (Art. Manoir). The name of turret was also given to actual towers flanking curtains, but whose small perimeter could contain but a very small number of defenders, a sort of watch-tower or turret. Gates of little castles were often furnished only with turrets. Today one habitually designates by this name cylindrical or polygonal works supported on corbels. These turrets rose





either from a corbel or a buttress; they afforded only a flanking of small extent and a view outside the habitation, of a gate or a curtain. Men scarcely began to employ them only during the 12 th century; the 13 th, 14 th, 15 th and 16 th centuries even gave great use of them, and certain residences of the 17 th century still possess them.

Note 1.p.190. Several turrets are still seen on mansions of the 17 th century in Rue Houtefille at Paris.

The turret is closed and communicates with the dwelling or defensive galleries only by a door. Thus it forms internally a little circular room, a cabinet or watch-box, and is most frequently covered by a cone of stone or of carpentry, lead or slate. The turrets frequently contained a screw stairs communicating from a second story to the upper parts of the edifice. Fig. 1 gives the plan and view of an angle turret of the 12 th century belonging to the oldest part of the castle of Veas. That turret is cylindrical and is placed on two buttresses, and three corbels filling the reentrant angles; consequently it was hollow only at the height of the third story. Bands and chevrons decorate its springing and cornice.

Enclosures of abbeys and small courts were often strengthened by turrets at the angles or at certain distances for placing watchmen. Sometimes even these turrets had two stories, one at the level of the defensive gallery, the other above, to which one ascended by a ladder. <sup>1</sup> This sort of turrets were actual watch-boxes, and were so called during the middle ages. <sup>2</sup> The two cylindrical turrets that flank the gate of the abbey of St. Michel-en-Mer are indeed little towers in the old sense of the word. Here (Fig. 2) is a perspective of that beautiful work built in alternate courses of rose and of gray granites in the height of the second story, and that dates from about 1260. <sup>3</sup> Those two turrets serve both for stairs and defenses in their upper part. The gate flanked by them is preceded by a little fort, and the entire construction is intact. <sup>4</sup> They are not conical roofs which crown the two cylinders, but platforms, to leave more freedom to the defenders.

Note 1.p.192. Art. Cloture, Fig. 5.

Note 2.p.192. Art. Echauguette.

Note 3.p.192. Art. Architecture monastique, Figs. 18, 19, that give the plans of that gate, at B and C of Fig. 18, and at A of Fig. 19.





Note 4. p.192. In *Archives des monuments historiques*, see the work of M. Devrez, architect on Mt. S. Michel-en-Mery.

The principal gate of the palace of the Popes at Avignon is likewise flanked by two little towers, whose arrangement merits attention.

This facade consists of a series of arches pierced by machicolations at the height of 49.2 ft. above the ground, and supporting a defensive gallery with buttresses, behind which the facade wall rises to the height of the roof and bears a second series of battlements.<sup>5</sup> The two turrets of the gate rest in horizontal courses on two piers of the arches forming machicolations, and profit by the projection of the defensive gallery to rise to the upper battlements (Fig. 3): thus they flank the two lower defensive galleries A and B, and add to the defenses of the gate.<sup>6</sup>

Note 5. p.192. Art. Poitou, Figs. 15, 16 (14 th century).

Note 6. p.192. The upper part of these turrets was still intact at the beginning of the (19 th) century; the work has been raised to the level of the defensive gallery since then, but there exist drawings and paintings in the library of Avignon, which permit it to be restored completely.

The pyramids crowning these two turrets were of stone and decorated by crockets. One will note that the corbels supporting the are circular in plan, while the turrets themselves are octagonal in plan, with ribs projecting at the angles and at the middle of the sides of the prism. This arrangement is not rare during the 15 th century.

Many mansions and even simple private houses possessed angle turrets, allowing windows to enfilade the streets, or engaged turrets containing stairs. (Art. maison, Figs. 13, 14, 15, 33, 34, 35, 39). Sometimes these turrets were also arranged to give little cabinets in the vicinity of occupied rooms. There existed a charming turret of that kind in the angle of the court of the mansion de la Tremoille at Paris: it formed a porch in the ground story before the passage leading to the garden.<sup>1</sup>

Note 1. p.194. Art. maison, Figs. 36, 37. Fragments of that turret were deposited in the court of the Ecole des Beaux Arts in Paris.- Also see *Architecture civile et domestique* by MM. Verdier & Cotte.

When turrets were corbelled, the constructors of the middle





ages devoted great care to the arrangement of the masonry and the distribution of the loads to avoid overthrow. These corbellings much below the internal floor of the turret, and the cylinder is complete, so as to be able to maintain itself at its centre of gravity. It is quite rare that an angle turret is drawn as indicated by the plan (Fig. 4, A), i.e., with three-fourths its area outside the lower construction. Most commonly either a buttress relieves a part of the overhang (see B), or more than one-fourth (at C). But the 15th century allowed itself boldness in construction and loved to show this. Then sometimes at that epoch angle turrets were erected according to sketch A. Then to prevent overturning, the entire portion a b c of the cylinder, it was necessary for the corbel to start sufficiently low as to be loaded by the angle h, before commencing the complete separation of the interior of the turret. The constructors proceeded thus. Let (Fig. 5) a section be made on b h; let g be the level of the floor of the story commencing with the lower floor of the turret. The starting of the corbel being placed at n, low enough that the load of the fourth of the plane n o p q resting on the angle stone is at least equivalent to the load n s t of three-fourths of the projecting corbel. For that purpose there was left at v a vacancy covered by an end of the floor. This open space in old turrets, where it exists, is taken as an intended secret hiding place.<sup>2</sup> The three-fourths of the cylinder overhanging were easily connected to the fourth engaged at the angle, but still it was essential that the engaged quarter should by itself be as heavy as the overhanging three-fourths; that is why the walls of corbelled turrets are very thin, frequently perforated, and present a horizontal section like that traced at D in our Fig. 5.

Note 2.p.194. I have seen a turret ruined where the owner of a manor had the idea of removing the massive angle forming a counterpoise, believing that this must enclose a treasure. It would also be very dangerous to fill with masonry the pretended secret places.

#### TRABES. Beam. Rood Beam.

The Latin word trabes adopted by the Church, signifying the wooden timbers placed across or around the choir, on which were placed lights or lamps were suspended. The abbey churches had





rood beams before the main altar (Art. Choeur). A crucifix was habitually fixed on the middle of the beam. These beams sometimes rested on four columns surrounding the altar. They were carved and painted, or were covered by goldsmith's work in copper or silver, <sup>1</sup> surmounted by arches in which burned lamps. Sometimes statues decorated them. <sup>2</sup> There no longer exists one of those beams in our old French churches, but some are still seen in the churches of Italy. The little monastic church of S. Jean-au-Bois in the forest of Compeigne still permits to be seen the two sawed ends of a beam of the 13<sup>th</sup> century covered by pretty paintings. Those ends rest on two capitals placed beside the piers at the entrance of the choir (Fig. 1). During the holy week was suspended from the rood beam the funereal veil that concealed the altar of the sanctuary. The custom of the rood beam is earlier than that of the rood screen and dates from the first time of Christianity. Like many other primitive customs, it is retained in the Greek Church, and we cannot state why these beams for supporting lights were suppressed in France. The abbey churches of S. Denis and of Cluny possessed magnificent rood beams ornamented by goldsmith's work and chandeliers of vermilion, which were placed between the stalls and the sanctuary.

Note 1.p.197. See Du Gange. Gloss.

Note 2.p.197. Latin Note.

#### TRAIT, ART DU. Art of Drawing. Detailing.

Thus is designated the operation, that consists in drawing full size on a surface the horizontal and vertical projections, sections and revolutions of the different parts of a structure, so that the stonemason can take off templates for the masonry; the carpenter can cut the timbers that compose a work in carpentry, the joiner can obtain the members of the joints of wainscot, doors, windows, etc.

Drawing is an operation of descriptive geometry, a separation of the multiple planes that compose the solids to be placed in the construction.

The art of drawing was developed during Grecian antiquity, but was nearly ignored by the constructors of the first period of the middle ages, and on seeing the Carlovingian monuments, it does not seem that the efforts attempted by Charlemagne to cause geometry to be taught to western architects produced sen-





sensible results. Only after the first crusades was perceived a notable development of these sciences in France. At the end of the 12 th century, the masters of works had resumed possession of geometry, and since that epoch their skill in that science increased from year to year until the end of the 15 th century.

The practice of descriptive geometry was very advanced among oriental peoples and among the Egyptians from a very distant epoch. After the transfer of the Roman empire to Byzantium, the mathematical sciences had powerful centres at Byzantium itself, Alexandria, later at Bagdad, and in the countries subject to the domination of the caliphs. The first crusaders found in Syria schools by which they benefited, and from the beginning of the 12 th century the art of projecting solids, of developing their surfaces was already practised in the West. If the elements of geometry seemed scarcely known to Carlovingian constructors, they were evidently familiar to the Cluniac architects, who erected the nave of Vezelay about 1100; and 30 years later in the construction of the porch of the same church, one perceives that these constructors have already an extensive knowledge of descriptive geometry, for all parts of that porch and notably the masonry are drawn with certainty and precision. Much more, in the drawings of that beautiful Cluniac school, one sees originate a system, no longer empirical like that of the constructors preceding the middle ages, but based on a principle, that is excellent in our eyes at least, because it is logical and true. We shall explain that method in some words. Every structure is erected to fulfil a purpose, proposes an aim for itself; it seems then that this is the object that must impose the means: this means is or must be essentially subordinate to the object. For example, a hall has a void covered area as its object; this void space is the object and not the piers or walls; these are and must be only the means of obtaining the void. Assume that the hall is vaulted, the vault covers the void space and is the essential part of the structure, because it is necessary to maintain it in the air: it is then the vault, its form, extent and weight, that determine the arrangement, the form and strength of the points of support. By logical deduction, the area to be covered and the means of covering it (being a vault) being given, the vault must first be





drawn, and its drawing imposes that of the piers or walls. In all things, it is the conclusion one desires to reach, that is required by the conditions, and no one will commence a book or a discourse without previously knowing, what he desires to demonstrate.

A method so natural, simple and logical, then opened a new field to architecture, such as would again be opened today, if men would take the trouble to apply it with rigor and utilizing the elements at our command. We state that then in the 12<sup>th</sup> century, this method opened a new field to art, because from the decadence of the antique, art only lived on very confused and corrupt traditions, whose elements were forgotten or not understood, because men rarely have themselves the trouble in architecture, no more than today, to make the premises accord with the conclusions, or the means with the purpose; they spoke for the sake of talking. In the midst of the confusion and ignorance of the practice of art, the introduction of a method satisfying the mind, easily applicable, which required at first only a knowledge of geometry of little extent, and was further capable of infinite improvements, as the result has proved, and as one recognizes when he desires to apply it, must produce one of those sudden developments occasionally marked in the history of the art. That is what occurred. Happily for the time, the Cluniac monasteries were the most intelligent in the West, and were at the head of instruction in all the sciences, that could then give a new direction to arts and letters. If one examines the monuments erected by those religious during the first half of the 12<sup>th</sup> century, he ascertains to what degree they had been able to assimilate that architecture, whose elements they had acquired in Syria, and also how they had fertilized these elements by subjecting them to a geometrical method rigorously deduced from the purpose. Henceforth in drawing the structure, it was the object supported, its shape, weight and logical position, that would impose the members and forms of the member that supported. Once again was then an advance, a new idea, for that idea had not been developed with that rigor, neither among the Greeks nor in Roman edifices. It would again be in our days one of the elements of progress in leaving this to the time, and in taking into account studies pursued in spite of academic restrictions, because it is singularly suited for





using the new materials, that industry supplies to us.

It must be stated, that to apply rigorously the method of drawing introduced by the masters after the middle of the 12th century, it was necessary for themselves to be draftsmen, and that the architectural forms should be combined according to the needs of the construction. It was essential for them to have constantly before their minds the practical means applicable, not only to the part, but to the entirety. They did not trust themselves to the operation of facing (derassing after erection), so convenient to conceal negligence, forgotten things or errors; for each stone from the hands of the workman must take just the place intended for it, according to the necessary form drawn in advance, to never be retouched. The system of vaulting invented by those masters about 1150, and so rapidly attaining its logical development, a system whose elements were entirely new, derived from a special method of drawing, rigorous in its principle, but very extended in its applications. In studying the edifices erected in that old France from 1130 to 1160, one easily discovers schools that must have trained the constructors during that period, the difficulties that arose from a still imperfect application of the method to be followed, the improvements developed as those masters entered farther into the true application of the system adopted. In fact thus is formed an art, and not by vague attempts, products of what is believed to be a spontaneous inspiration, or of a cloudy eclecticism, attached to no fixed principle. In architecture, everything is a problem to be solved; established traditions may be followed, and long furnish a career to the artist, but if those traditions fail, or be recognized as insufficient, for art not to fall into the last degree of weakness, it needs to resort to absolute principles, and must adopt a logical method in its course, close in its application. The masters of the 12th century so understood their part, and if they have left us writings to tell us, they have erected sufficient monuments still active, to prove it to us. Then the developments of religious and military architecture chiefly occupied these masters, and yet the principles that they adopted extend to all other branches of art. Once in the path logically traced, they did not leave it, for it led them as well to the construction of the church in novel forms, as to that of the fortress, the palace and the house.





We have been so strongly unaccustomed to reason, when this concerns architecture; the academical formulas are so hostile to examination, and just appreciation of the purpose, the need and the practical means, that in our days necessity being the law and being superior to the prejudices of the schools, the architects have seen arise beside them a powerful body probably destined to absorb them. Those that we term engineers on the whole do nothing else, than the lay masters did about the middle of the 12th century. They take as the law, the need exactly fulfilled by the truest and simplest means. If their method has not yet been able to develop new art forms, this must be due to the influences of schools, from which they have not yet dared to withdraw themselves entirely. They succeeded in freeing themselves, as one cannot doubt, for again necessity compelled them to this; the example that we present here will sooner or later end by convincing them, that those are degenerate traditions with which they must break; that such an art as architecture is not renewed by assimilating earlier forms without passing them through a careful examination, but much rather by starting from a principle established on reasoning and on logic.

Perhaps the monks of the 12th century expressed their regrets at seeing abandoned the traditions of Romanesque art and the remains of the antique arts, at the sight of the new school of lay masters, who sought to establish their system on examination, geometrical procedures and the strict observation of the requirement; their complaints have not come to us, and besides if those occurred, the social movement that claimed to remove civilization from their exclusive influence was strongest. The schools of the monasteries themselves, although powerful, were carried along after the 12th century, so far is the monastic establishment that had retained the schools of masters of works. Yet it is necessary to render to these establishments the justice due them, they had commenced (the Cluniacs among all) the learned revolution, that was to renew the art of architecture. In their schools, as we have just stated, the study of geometry was evidently in honor from the first half of the 12th century. They commenced the ruin of Romanesque art, perhaps unconsciously, or at least they did not pretend to establish hieratism. Assuming that they may have recognized the danger that menaced Romanesque traditions, they did not have to combat





this, irrational eclecticism of our academies of modern art, since they scarcely knew more than one architectural form, that which they had practised. A mark of genius seems to have caused this revolution in the art of building. Suger caused the church of S. Denis to be rebuilt in 1137. It was completed or nearly so in 1141. Then one already sees appear the system of construction termed Gothic in what remains to us of that monument.

The vaults contribute the most important part of this system, and are conceived outside of Romanesque principles. Fig. 1 explains the tracing of the part remaining around the choir erected by Suger. The round arch has completely disappeared; all the arches are pointed, and their horizontal projections imperatively require the place and form of the piers. In other terms, the architect must have first traced the vaults on his plan before deciding the arrangement of the piers. His intention evidently was to seek half arches of equal span as much as possible, since in all the part occupied by the chapels and the double side aisles, it was necessary for the crowns of the vaults to be on a level or nearly so.

The piers A, B, C, D, E, and the archivolts A B, B C, C D, were rebuilt under S. Louis, but the plinths of the piers A, B, C, date from the epoch of Suger. As for the high vaults of the sanctuary, they were likewise rebuilt in the 13<sup>th</sup> century. Thus we occupy ourselves only with the part comprising the chapels of the double side aisle belonging to the construction of 1137.

One will note that the half diagonal arches a b, c d, d e, d f, etc., are sensibly equal. From the moment that the pointed arch is adopted, small differences in span of these half arches do not prevent their crowns from attaining the same level. The crowns of the transverse arches F G, H I (pointed arches), are at a level lower than the crowns b and d; this must be, since the spans F g, g G, etc., of these arches are less than those of the half diagonal arches. As for the transverse arches K l drawn on a circular horizontal plan, their crowns are at a level intermediate between that of the crowns b d and that of the crowns g h. The crowns m of the side arches neither reach the level of the crowns d. It results from this, that the vaults L K l f e, L K F O, are sensibly swelled upward.<sup>1</sup> These arches of the vault and their revolutions being drawn, the master of





works has projected their imposts on the points on which they must rest, as we have indicated at P for the column p, the profile of the transverse arch being n and that of the diagonal arches S; -- these imposts have imposed the form and dimensions of the abacuses, and consequently those of the capital of the column: so that (see the detail R of a chapel) these columns take a diameter according to the strength or number of arches that they support, which is perfectly reasonable and logical.

There exists a notable irregularity in the general drawing of these chapels and side aisles of the choir of the church S. Denis. The projections of the transverse arches normal to the circular arc A B C do not tend to the centre Q of this circle. The centre of the second arc L K is at T on the main axis beyond the centre Q, while the centre of the third arc d d', on which are placed the centres of the semicircular chapels is at Q, and that of the head e I of the chapels is at V. Thus the transverse arch H I, more again than x i, also more than p r. On the contrary, the transverse arch O a has less span than F G, etc. If we prolong to the main axis the horizontal projections of the transverse arches A e, B I, C i, D p, we see that only the line A e falls on the centre T, and that the others strike the main axis beyond that point. The draftsman has balanced these lines as one balances the treads of a stairs in a winding portion, to avoid too great differences, that would be given by the sectors at each of their extremities. In fact, if the master had drawn the rays tending to a centre, the arches at the entrances of the chapels would have had spans out of proportion to those of the archivolts A B of the sanctuary. The drawing of the arches of the vaults would have become more difficult, or rather the considerable variation in the lengths of the half arches would have been an embarrassment for the constructor, without counting the bad effect produced in the eye.

There is also in these irregularities, appreciated only on a plan accurately laid out, an intended perspective effect. It must be recalled that the place Z in the sanctuary was occupied by a magnificent altar with the shrine of the martyrs, all restored with luxury by Suger, and that because of the deviation of the radii of the chapels, ceremonies performed before the altar of relics really occurred at the centre of these chapels. As for the greater opening of the transverse arches c e, relat-





relatively to those of the transverse arches of the front chapels, this was a means of giving more depth to the church on its main axis, and for opposing the effect of foreshortening of the apse produced by perspective.

These refinements seem strange to us today, and rather than seek their sense or verify the results, we prefer to place these defects in location to the account of the ignorance of those old artists, free to marvel tomorrow at the no less important irregularities found in the monuments of Greek antiquity; irregularities that result from a need of the eye, and from a very delicate appreciation of the perspective effects. Thus having two weights and two measures, disdaining here what we admire there, we do not take account elsewhere in our structures, of these consequences of the laws of perspective. It must be admitted, that if it was easy to modify the widths of the intercolumniations or the diameters of the columns in a Greek portico, since these researches do not modify the system of construction with lintels, it is much less so to apply these laws, imposed by a need of the eye, to vaulted edifices. It is necessary for the system of vaults adopted, to lend itself to these liberties; this is also what occurs when one abandons the Roman and the Romanesque vaults to introduce a new construction. Those masters of the 12th century, so refined in their conceptions, largely profited by the facilities afforded by the new system of French vaults for obtaining grand effects by the aid of simple and practical means. Once the general plan was obtained, there was no embarrassment in turning an arch according to an angle more or less open. It sufficed to draw on the area the direction of that arch and its revolution. The template of the voussoir placed perpendicularly to that direction gives the springing of the arch. By collecting all those templates at one point the impost is composed; next according to the forms of the voussoirs and the direction of the arches, the capital is traced that must support the impost. The capital being drawn, one has the column or pier. Thus it was by the general drawing of the vaults that the master commenced the graphical work of the plan. It is true that such a method required a very complete practice in geometry, not only on the part of the master, but also with the detailers, for it was necessary at each impost to take into account the penetration of the surfaces





that were grouped in clusters; but men will probably not claim, that this knowledge carried very far by the master and easily understood by the assistants, was ever a mark of ignorance and barbarism. Having laid before the eyes of our readers one of those general drawings, it is necessary to penetrate farther into the methods of detail. Let us take one of the simplest. Let (Fig. 2) be the jamb of a doorway with external recessions. This splay must necessarily be covered by arches. For making these arches we shall take stones of dimensions proportioned to their spans. Let A B be a scale to one toise (6.5 ft.) Dimensions of 1.1 ft. will be given to the voussoirs; the splay having a depth of 4.4 ft., four superposed rows of voussoirs will cover it. On the tympanum T as a centering, we shall draw the first row B of voussoirs; on this first row the second C, and thus for the two others, D and E. An archivolt band F will enclose the four rows. The horizontal projection B C D E of the impostes of these voussoirs will give the dimensions of the capitals, whose upper squares G will then have 1.1 ft. on each of the two visible sides. According to the projection that we wish to give these capitals from the shafts of the columns, we draw the latter. If they must be engaged, these shafts are drawn tangent to the sides a, b (see detail H); then the capitals themselves will be engaged, and their centres will be at d. If we prefer these capitals to be entire, we draw the shaft of the column with its centre at the middle i of the square. The two methods were adopted in the 12<sup>th</sup> century, but the second is rarer in the French provinces than the first. The projection of the abacus will be free and will be regularly profiled around the top of the capital. This projection will stop the band F of the archivolt. Farther, the horizontal projection of the capitals and their abacuses will give those of the bases and their plinths, as proved by the vertical projection L. This is a very simple detail, since it is only necessary to draw a series of concentric archivolts, emphasizes the dominant principle. These are the arches and their horizontal projection, which determine the form of the capitals, shafts and bases of the columns. The master must draw these rows of arches before drawing the ground plan.

Note 1.p.206. Art. Porte, Figs. 53, 59, 60, 62, 63, 64.

It if be necessary to draw the arches of a nave and their sup-





supports, the operation is (necessarily) more complicated. In architecture as in everything, when a new principle is adopted, the first applications made of it are not the simplest. Our steam engines are less complicated than were those of the beginning of the (19<sup>th</sup>) century; it is only by study that man comes to simplify what his genius first made him invent.

Let us place in parallel two systems of piers of naves supporting cross vaults (Fig. 3). That at A belongs to the cathedral of Paris; the other is from the cathedral church of Rheims. The first dates from 1195, the second from about 1220. Let us glance at the section of the nave of the church of Notre Dame of Paris. (Art. Cathédrale, Fig. 2). We shall see that the cylindrical piers support in the ground story two archivolts, a transverse arch, two diagonal arches, and a group of three little columns destined to support the arches of the high vaults; in the second story, a vaulted gallery, i.e., a transverse arch and two diagonal arches; at the height of the windows, a buttress, the wall pierced by openings, two little columns for the side arches, the transverse arch and the two diagonal arches of the high vaults. In retaining the system of cylindrical piers, the master of works certainly believed that he started from a simple principle, and yet this first point must cause him embarrassment and require complications in the drawings.

On our Fig. 2 at A is seen the horizontal projection of all those members superposed on the half circumference of the cylindrical pier. On that perimeter the draftsman starts the transverse arch a and the diagonal arch b of the side aisle, the archivolt c c d with two rows of voussours supporting the longitudinal structure, the little column e and that at f destined to carry the transverse arch and the diagonal arches of the high vaults. To receive these members, he traced the abacus of the capital square with angles cut off, which does not prevent the horizontal surfaces v supporting nothing. This first drawing receives the plan of the piers at the level of the gallery, the plan found in g h i j k. Against the inner side of this pier were drawn the little columns l of the transverse arches and m of the diagonal arches of that gallery. The horizontal projections of the arches of these vaults are the same as those of the arches a b of the vaults of the side aisles. The opening of the gallery being enclosed by an archivolt, the horizontal projection





of that archivolt was drawn at *n* and *s*, projecting toward the nave to *n'*, the face of the tympanum of the lower archivolt to form a projection over the capital of the angle pilaster (Art. Cathédrale, Fig. 4). As for the internal archivolt *s*, it serves as a side arch for the vault of the gallery. To open the arch better, the little archivolts forming the arch (Art. Cathédrale, Fig. 4), start at *t* on the pilaster *i*, and not on the little column. The external face of the wall over the gallery being at *u*, borne on the side arch *s*, the external buttress is at *X* *X'*. (Art. Cathédrale, Fig. 2).

The little columns *e* and *f* continue to rise and receive the transverse arch *e'* and the diagonal arch *f*, whose impost is projected on our Fig. These springings give the form of the capitals and abacuses traced at *y*. On the projection *Z* of this abacus remaining square rests the base of the little column *W*, that bears the side arch of the high vault. It should not be forgotten that these high vaults are hexapartite, that the diagonal arches occupy two bays, and consequently give a horizontal projection of near  $45^\circ$ . The difficulties in drawing would have been increased, if these diagonal arches had been the diagonals of a single bay.

By this example one sees what complications and what experiments would result from the incomplete use of a method, the principle being once adopted. The arrangement really commences only above the abacus of the great capital, and this arrangement is restricted by this need of a square abacus set parallel to the main axis of the nave. The architect has proceeded logically for the upper part; he has first traced his arches of the vaults, and that has given him the form, the place and the dimensions of the supports; but this square surface in which it is necessary to remain, and which was given to him by the lower cylinder, obliged him to combine the members, to confuse them with each other to find their places. Yet in spite of efforts, he has left unoccupied surfaces on these abacuses, too limited in two directions. Desiring to have cylindrical piers in the ground story, and adopting the arrangement of the new construction, it would have been more logical and simpler to place the abacuses diagonally, since it was parallel and perpendicular to the main axis of the nave, that he must develop the members of the construction. In fact, if the abacuses had been drawn





as we have indicated at G, the draftsman placing the diagonals in the direction of the development of the supporting members; he would have been less restricted and would have left no surfaces unoccupied. As one indeed thinks, this reasoning was soon followed by the masters after the beginning of the 13<sup>th</sup> century. The cathedral of Rheims was founded in 1212; the part of the nave adjoining the transepts was erected about 1220, 25 years after the construction of the piers of the nave of Notre Dame of Paris. The plan B (Fig. 3) gives half the horizontal projection of one of the piers of Notre Dame of Rheims (old part), with the members supported by these piers. The architect returns to the cylindrical pier, but he diminishes its relative diameter, and he attaches to it four engaged columns.<sup>1</sup> On that pier (Art. Cathedrale, Fig. 14), he places a capital, or rather a group of capitals (Art. Chapiteau, Fig. 23), whose combined abacuses adopt the general form indicated in G. But by these columns engaged to the cylinder and the frank form of the abacuses, the arrangement commencing above this pier is connected to the lower part. In fact, the engaged column C (next the nave) supports another column with a diameter slightly less than that of the two little columns D, which extend to the high vaults to receive the transverse arch F and the two diagonal arches H. The engaged column K supports the longitudinal archivolt whose width is K'K'', and above appears the pier L M N of the triforium with its little column O, then the jamb of the upper window U U'U'' enclosed by the side arch of the high vault, whose little column is at I. The engaged column P bears the transverse arch Q; above the rear wall of the triforium R is joined to the closing wall of the internal passage S S'. On the pier is detached the column T'' against the buttress with external passage. The diagonal arches of the vaults of the side aisles are at V, their trace on the abacus being V'.<sup>1</sup> The advance from the preceding example is very evident. All the members have their places, no longer interfering with each other; thus at Notre Dame of Rheims the stability is perfect, the effect clear and the appearance is reassuring. The logical consequences of the principle however must be pushed yet farther.

Note 1.p.208. An attempt of this kind had been made already in the part of the nave of Notre Dame of Paris next the towers, whose construction dates from about 1215.





Note 1.p.209. To properly know the place and function of all these members, it is necessary to have recourse of Fig. 14 and Art. gothedrole.

In 1231 was commenced the work of reconstruction of the nave of the abbey church of S. Denis. The architect charged with that rebuilding remains unknown, like most masters of works of that epoch. But the edifice that he has left to us indicates in all its parts a certainty and perfection rare in the art of drawing.

As we have just done for the cathedrals of Paris and of Rheims, let us take one of the piers of the nave, and see how different stories of the structure rest on this pier. The last traces of the cylindrical column, that accords so little with the different members of the vaults, are effaced; the arches and those vaults absolutely determine the form of the pier. The longitudinal archivolts consist of two rows of voussoirs, according to custom; <sup>2</sup> the transverse arches of the vaults of the side aisle, that receive the stone floors of the terraces, are composed of the same number of voussoirs; then are necessary the places of the diagonal arches. The high vaults consist of a transverse arch only supporting the fillings and having a single row of voussoirs 13 ins. wide, two diagonal and two side arches, that enclose the tracery of the windows. The necessary positions of these members of the vaults rigorously determine the form and number of the members of the pier. In fact (Fig. 4), the transverse arch of the vaults of the side aisle comprises the two members a' and b'; the diagonal arch has the member c. The transverse arch of the high vaults consists of the member d, a diagonal arch of the same vaults, and of the member e. The horizontal projection of the imposts of those arches is traced on our Fig. with their profiles. The diagonal arch c of the side aisle can start and take its curvature before the half b of the transverse arch, so that this diagonal arch rests on the bearing that serves as support for that half b; thus the two projections are seen to intersect on c. The pier consists of a single engaged column for these two combined members. The projections of these arches are further exactly comprised within the lines f g h i j k l m n o p intersecting at right angles and forming the block of the pier. The engaged columns are traced within these lines, their centres being on the diagonals,





so as to give the projection of the capitals, whose tops under the projecting abacuses is this projection  $f\ g\ h\ i\ k$ , etc. For the arches of the great vaults is traced a special cluster of engaged columns  $q\ r$ ; the abacuses of the capitals of these arches are drawn in  $s\ t\ u\ v$ ; the projections of the abacuses of the other capitals in  $f'h'k'$ , etc. At the side A of our Fig. is drawn the pier with its bases. Above the longitudinal archivolts at the height of the triforium is separated the little engaged column B, which supports the side arch of the interior. At D E F G H is drawn the pier at the level of the triforium. The passage is at P, the perforated wall of this triforium is at I, and the external buttress at K L. Above the triforium is drawn the window with its little column M, that bears externally the enclosing arch, that is only the side arch itself; thus the centre of this little column M is on the same line as that of the little column B. At the level of the windows is placed on the buttress K L the isolated column N, which receives the head of the flying buttress, and which leaves a passage above the triforium between it and the pier O Q.

Note 2.p.209. Art. Architecture religieuse, Fig. 36. This engraving gives in perspective the section of the nave of the abbey church of S. Denis.

It is easy to recognize that this last drawing is preferable to the two former. This is more clear and logical. The arches of the vaults each have their support; the capitals of these supports are clearly accented by the blocks of these arches ~~concentrated~~ <sup>centered</sup> within the rectangular parts. The projections of the bases of those of the capitals are the same, except for the bases that the angles judiciously cut off at W, so as not to restrict passage.

In this path, the masters of the middle ages could stop only at the final limit. Men in our country do not submit to logic with impunity. It pushes us onward, and carries us to the limits of the possible. Fifty years at most after the adoption of these principles of drawing, the architects arrived at giving to the piers exactly the same horizontal section as that of the arches; one can take this fact into account by examining Figs. 15, 16 and 17. of Art. Pilier. These methods led them to conceive a construction only by traces of horizontal projections superposed, and naturally the plans of the upper parts (comple-





(completion of the work), that determined the horizontal sections of the lower parts. From the time of Villard of Honnecourt, men still adhered to drawings conceived in the spirit of those that we have just presented. One finds among the sketches of that architect indications, that agree accurately with the methods suggested by the study of the monuments of that epoch.<sup>1</sup>

Note 1.p.211. See Album de Villard de Honnecourt. From the original manuscript, published by J. B. Lemaire and A. Duval. 1858.

Villard of Honnecourt gives some plans of vaulted edifices, and one can verify that the drawing of those plans is essentially derived from the necessities of the construction of the vaults. This fact is evident to whoever will glance at the plans of the cathedrals of Cambrai and of Meaux,<sup>1</sup> at the plan conceived and discussed between Villard and Pierre of Corbie,<sup>2</sup> on that of the choir of Notre Dame of Vaucelles, of the order of Citeaux.<sup>3</sup> This last plan, whose principle we give (Fig. 5), is one of the most beautiful conceptions of the beginning of the 13<sup>th</sup> century.<sup>4</sup> The method of drawing the apse is simple. The quadrant A B was divided into 7 parts. Each of these radii gives either the position of the piers a b, c d, or the centres of the vaults e f g h, etc. The circular chapels are adroitly connected to the side aisle, while leaving easy passage. The arches of the vaults are combined in a way to give half arches of nearly equal development. A general plan being thus traced, the architect had the direction of each arch. He decided on their sections, then placing these sections on the imposts according to the direction indicated, he derived from this the drawing of the pier.

Note 1.p.212. Plotes 28 and 28.

Note 2.p.212. Plote 28.

Note 3.p.212. Plote 32.

Note 4.p.212. The Clisterion church of Vaucelles was erected at some miles from Combray; it was dedicated in 1235 by Henri de Dreux, archbishop of Rheims. It was still standing in 1713, and was only destroyed at the end of the last (18<sup>th</sup>) century.

We have frequently had occasion in the course of this Dictionnaire to give general and detail drawings of edifices, but it does not seem useful to insist here on the geometrical procedures of those drawings. What is important is to emphasize is, that the systematic side of those procedures, either as con-





concerning the composition or as concerning the construction and the value or form to be given to the various members.

Those who deny the utility that can be derived from the study of our architecture of the middle ages, because most frequently they have not taken the trouble to know its spirit and elements, or pretend to regard our researches as a tendency to a purely material revival of the forms adopted by the artists of those distant epochs (although we have always said and written that these studies should only be regarded as a means, and not as the type of an unchangeable art), sometimes disdaining this architecture because they believe it to be only construction and not art; sometimes accusing it of allowing itself to be led into the strangest caprices, or even to be subtle and bold beyond measure; to be the result of ignorance suddenly aroused, or of science without choice of form; to be poor in invention, or rich to excess in details, hieratic or capricious; so that if by chance had to combine those appreciations, the difficulty would be to harmonize them before opposing the excess and error in them. Yet if one examines with care the methods employed by these masters of the middle ages, he recognizes at once that they are derived from definite and clear principles, established on profound and judicious observation of the conditions imposed on the architecture in general, whatever the surroundings or the time; that its methods are developed according to a logical procedure in its course, faithfully applied in practice.

No architecture can bear better than ours during the best period of the middle ages, this superposition of the plans of a structure, a superposition which shows that no member is superfluous, that all have their places marked from the basis. [Let one try to make proof of this; and with the smallest portion of good faith (yet some is necessary), he will very quickly recognize, that neither Greek nor even Roman architecture, so frequently rational, possesses to the same degree these logical qualities of construction.

"The system of drawing of our architecture of the middle ages, from the 12 th to the end of the 15 th centuries, can be summarized in these few words:—" the object supported determines the form of the support; " and that without being able to find a single exception to this so simple and natural law. It is far





from this system to the absence of all system, which causes us, among other examples, to erect columns along a wall to support nothing at all, and to occupy the eyes of idlers, we frankly admit; but to regard as progress that forgetting the most natural laws of architecture, and to assume scornful airs before the works of artists, who have applied rigorous reasoning to what they were doing, when men have lost the habit of reasoning, would cause a smile, were it not so costly.

#### TRANSEPT. Transverse Aisle. Transepts and Crossing.

A word derived from Latin and that several write transcept. We prefer to adopt the orthography transept, from trans and sepire, to enclose beyond. In fact, in the primitive basilicas and in the old monastic churches, the enclosure of the choir is placed in the transverse aisle, the apse being reserved for the sanctuary.

The Roman basilica sometimes possessed a transverse aisle, i.e., a transverse space between the tribunal and the aisles. In the basilica of the forum of Trajan (basilica Emilia), the tribunal occupied the width of the five aisles; the side aisles returned before the semicircle; <sup>1</sup> then where these side aisles formed a sort of transverse aisle, where between them and the tribunal remained an interval required for the construction of the roof. Several Christian basilicas of the first centuries possessed a transverse aisle. On that principle is constructed the basilica of the Nativity at Bethlehem, which dates from the 6th century. The basilica of S. Paul-without-the-walls (Rome) was commenced in 386 and entirely completed under the reign of Honorius, was restored several times, and notably in the 13th century possessed a vast transverse aisle, belonging to the Theodosian arrangement. This primitive transverse aisle formed a sort of separate work, and studied with the texts relating to the first Christian liturgy, it presents an arrangement of great interest, that one finds again in the basilicas of S. Peter of Rome, S. John Lateran, S. Maria Maggiore, and S. Peter in Bonds. (Rome). <sup>2</sup>

Note 1.p.214. See the fragments of the plan of the Capitol.

Note 2.p.214. We advise our readers to consult on this subject the excellent work of M. Henry Hubsch; *Monuments de l'architecture chretienne*, translated by Abbe Guerber (1866. Morel edition).





This collection of churches of the first centuries was made with rare care, and shows how scrupulously our neighbors beyond the Rhine examine the field of archaeological studies.

The plan of the basilica of S. Paul-without-the-Walls gives us this transverse aisle of the well marked primitive church. The principal nave and the four side aisles (Fig. 1) are separated from the transverse aisle by a wall pierced by a triumphal arch and four secondary arches. The main altar is placed at A, and with its enclosure over the crypt (confessio) separates the choir B, occupied by the chiefs among the clergy, from the believers placed in the nave.

The transepts were filled by clerics and persons clothed with a religious character. It should not be forgotten that in the first centuries of Christianity, the altar was surrounded by veils, that were opened only at certain moments in the offices; thus the transverse aisle was the sacred place, the cell into which the laity did not enter. A last tradition of pagan worship, and also a custom of the Jews, that we find retained in the liturgy of the Greeks.

The transverse aisle was of small extent in the Roman basilica, when it exists, but assumes considerable relative importance in the great primitive Christian basilicas; the transverse aisle gives the Christian edifice its religious character, for the aisles are only a place of assembly. Thus it did not cease to be employed in monastic churches. The plan of the church of the abbey of S. Gall (Switzerland) indicates a transverse aisle in front of the main altar, a transverse aisle that contains the choir of the religious and the ambos. The remains of the abbey church of S. Denis built by Dagobert, and found again by us beneath the pavement of the church of Suger, showed the transverse aisle before the semicircular apse. We see a sort of transverse aisle emphasized before the sanctuary of the little church of Vignory, whose construction dates in the 10<sup>th</sup> century.<sup>1</sup> In the abbey church of S. Savin near Poitiers, which dates from the 11<sup>th</sup> century, a very prominent transverse aisle separates the nave from the sanctuary.<sup>2</sup>

Note 1. p. 216. Art. Architecture religieuse, Fig. 2.

Note 2. p. 216. The same, Fig. 11.

Yet the transverse aisle did not appear in the same manner and at the same time in the different schools of religious ar-





architecture of ancient Gaul. If it seems inherent in the plan of the churches of the southern provinces, it only appears later and in a manner less frank in the provinces of the North. As for the abbey churches, the oldest, they are always provided with extended transverse aisles. This arrangement was imperatively demanded by the religious service of the Benedictine monks, and it was followed by the Cisterians in the structures that they erected in the 12<sup>th</sup> century. The abbey of Cluny even possessed two vast transverse aisles only separated by two bays of the nave. <sup>3</sup>

Note 3.p.216. Art. *Architectura monastica*, Pl. 2.

Before the absolute adoption of vaults in the construction of churches, the arrangement of the transverse aisle already presented to architects serious difficulties; for if it be easy to place roof trusses on the parallel walls of the nave, it is less easy to cover by carpentry a square area when having only the corners as points of support. Thus in the oldest basilicas with transverse aisles, where the walls of these transverse aisles rise above those of the high nave, and the carpentry then rests on transverse arches spanning the width of the nave; and on the contrary the walls of the transverse aisle are lower than those of the nave, and its carpentry rests on arches spanning the width of the transverse aisle. Also sometimes four transverse arches are turned at the intersection of the nave with the transverse aisle; on those arches rises a sort of square tower, that has its separate carpentry with two gables. For example, this arrangement is adopted in the monastic church of Montreale near Palermo, <sup>4</sup> and in the cathedral of Cefalu (Sicily), both built under the Norman domination in the 12<sup>th</sup> century. There is every reason to believe that the church erected in France and particularly in Normandy, in the 11<sup>th</sup> century, presents this arrangement. Vaults having replaced all visible carpentry in those edifices during the 12<sup>th</sup> and 13<sup>th</sup> centuries, one can only furnish presumptions in that respect; but the central vault of the Norman transverse aisle forms a lantern and seems to be a tradition of elevated carpentry, that we still find at Cefalu and at Montreale near Palermo.

Note 4.p.216. See the work of the duke de Serrillolco; *Del duomo di Montreale. Palermo. 1838.*

But (as we have already stated), in the monastic churches in





Gaul we see the transverse aisle frankly emphasized from the older epoch. The plan of the primitive church of S. Remi at Rheims is still visible in spite of the modifications that it has suffered, possesses a very extended transverse aisle, on which open five eastern chapels, besides the sanctuary. This transept and the nave were originally covered by carpentry with four transverse arches at the intersections of the walls. We give its plan (Fig. 2),<sup>1</sup> that only differs from that of the great basilica of S. Paul-without-the-Walls of Rome only by the side aisle of the choir and the addition of chapels. Here again the religious occupy this vast transverse structure, and the nave was reserved for believers.

Note 1.p.217. In this plan old block ports still exist; those hatched were replaced by constructions dating from the end of the 13th century, and are only visible in the foundations. The old ports date from the 10th century.

At S. Remi, the choir of the religious was then at A and the altar at B; the shrine of S. Remi was at C. The side aisles of the church of the 10th century were vaulted by means of tunnel vaults resting on transverse arches perpendicular to the axes of the nave and transverse aisle. A triforium or gallery covered by carpentry placed on arches rose above the side aisles and under the high windows of the nave. (Art. Travee, Fig. 1).

Later the principle of the primitive arrangement of the transverse aisle was lost, and the believers invaded the aisles; a side aisle extends around the sanctuary, except in the least important churches; it is furnished with numerous chapels; during the offices the religious further occupied only the crossing and the last bays of the centre aisle. Then the middle of the apse became a sacred place, reserved for the deposit of relics and treasures, to which believers were not admitted. That apse gains in depth; the altar of the religious remains beneath its transverse arch at the entrance or advances to the middle of the crossing. This transformation occurred in the abbey church of S. Remi itself at the end of the 12th century. The choir of the religious was placed at D; the semicircle behind the altar was much deeper, and still contained the shrine of the S. bishop, but the faithful turned around this sanctuary closed by an enclosure and had access to the radiating chapels built on a very great scale.





About the end of the 11<sup>th</sup> century, when it was decided to replace by vaults the carpentry of the high naves, men commenced by establishing tunnel vaults; they did not dare to undertake to construch cross vaults of great span; <sup>1</sup> but at the centre of the crossing were compelled either to make a cross vault at the intersection of the tunnel vaults, or a dome. They decided for the latter, they distrusted so much the stability of great cross vaults in the Roman style.

Note 1.p.218. The nave of the abbey church of Vezelay was built about 1100 and forms an exception. There they attempted to build cloister vaults, (Arts. Architecture religieuse, Fig. 21; Travee, Fig. A), which are rather domes with folds at the imposts.

The pretty churches of Auvergne, all built on nearly the same pattern about 1100, <sup>1</sup> furnish us with several examples of plans with transverse aisle and very judiciously conceived. The plan (Fig. 3) of the church of Issoire leaves the primitive form in the arrangement of the transverse aisle. On the four piers of the crossing are turned four transverse arches, that bear little pendentives in the corners forming an octagon; on this octagon rises a domical vault abutted laterally at a and b by half tunnel vaults; <sup>2</sup> over the dome rises a tower. The sanctuary A is raised several steps above the pavement of the transverse and the circular side aisle. Two stairs descend into the crypt. Believers had access everywhere, except in the sanctuary, and in fact the two transepts c, d, are only appendages of the two eastern chapels e, f. This plan is so well conceived, that it must give in elevation a motive of great originality, and which abandons the principles adopted until then.

Note 1.p.219. Notre dome du Port, S. Nectaire, Issoire, Ebreuil; church S. Eternae od Nevers must be placed among the religious monuments of this beautiful school of Auvergne.

Note 2.p.219. Art. Architecture religieuse, Fig. 10 bis.

Here (Fig. 4) is the perspective view of the apse of the church of Issoire with its transverse aisle. One sees that the two ends of the arms of the cross near the eastern chapels do not rise above the nave and the apse; but the two parts a, b, of the plan, which receive the half tunnel vaults, designed to abut the dome, form a first tier with grand effect, that leads the eye to the second tier enclosing the dome and bearing the





central tower. Unfortunately those upper parts have been made heavier and disfigured at different epochs, but it is easy to recognize on the monument itself, and by the examination of the constructions, the primitive arrangements beneath the excrescences that take away a part of its grace. Materials of different colors in certain places form mosaics, that give refinement and elegance to this structure skilfully arranged in stories. The Auvergne plans form a school, and had their imitators in Nivernais at the North; even in Limousin and Languedoc at the South. However, in these last southern provinces, these imitations only seem to be applied to abbey churches.

The most important of all is certainly the celebrated church of S. Sernin (S. Saturnin) of Toulouse, whose choir and transverse aisle date from the beginning of the 12<sup>th</sup> century.

Fig. 5 gives at A half the plan of its apse with the transverse aisle and a portion of the nave. Here the transverse aisle is no longer reserved for the religious, and they remain in the choir placed in C, while the altar was established at a on the crypt enclosing the tomb of S. Saturnin. At b was a rear altar, reserved for certain ceremonies. At the north and south ends of the transverse aisle are pierced wide doorways p, p, that we fully show at P; doors made for believers, or rather for pilgrims that came in great numbers on certain days to the church of S. Sernin. The nave has double side aisles, and one of the two continues entirely along the transept and the sanctuary. A vaulted triforium surmounts these side aisles. This grand arrangement was followed about the same epoch at the construction of the church of Conques. We give at B also half the plan of its apse and its transverse aisle. In the church of Conques, the religious occupied the same place as at S. Sernin. At Conques believers had no access to the church by the ends of the transepts but only by the side doors m. These plans sufficiently emphasize the importance assumed by the transverse aisle in monastic churches. Originally reserved for the religious or clerics, it was left to believers after the 12<sup>th</sup> century; at this time it even occupies a greater surface, so as to allow the pilgrims, who attended in this abbey church, to be present in great numbers at the ceremonies of the worship, and to easily see the sacred bodies taken from the crypt at certain seasons of the year, and exposed in the middle of the church. <sup>1</sup>





This programme, made for the construction of Benedictine and Cistercian churches about the beginning of the 12 th century, was rigorously followed during the following centuries. On the contrary, we see cathedrals rise in France on varied plans, according to the provinces, and in those edifices the transverse aisle, so frankly and universally adopted for Benedictine and Cistercian churches, only appears here and there or at a relatively recent epoch. Certain churches of the South and of the Centre, like the cathedral of Angoulême, alone have the privilege of possessing accented transverse aisles; <sup>2</sup> but those monuments precede the movement in the North, that caused the reconstruction of all episcopal churches. We have sufficiently explained elsewhere the nature and importance of this political movement, that it is unnecessary to return to that subject here. It will suffice for us to state this fact, that the greater part of the cathedrals commenced during the second half of the 12 th century in the royal domain, were originally erected without a transverse aisle. The cathedrals of Senlis and Meaux had no transepts; that of Paris was certainly projected without those appendages; <sup>2</sup> that of Bourges has none, and at Sens, it is easy to recognize how they were established long after the construction of the cathedral church.

Note 1.p.222. Art. Architecture monastique, on that subject.

Note 2.p.222. Art. Cathédrale, Figs. 41, 43, 27, 28, 34.

Note 3.p.222. We obtained the proof of this in the foundations and above the vaults of the crossong. Very probably it was not decided at Paris to give a transverse aisle to the cathedral only after the completion of the choir, i.e., after the death of Maurice de Sully.

Excavations recently made in that edifice at our request by M. Lence, diocesan architect, measured and drawn with the greatest care by M. Lefort, inspector of works, have uncovered not only the foundations, but the lower courses of the old piers in the axis of the present transverse aisle. Fig. 6 gives the plan of the later part of the cathedral of Sens. This plan was restored from the excavations, and only allows to be seen an embryo of a transverse aisle indicated by two chapels, C, C. <sup>4</sup> The nave and side aisles are divided in equal bays without interruption, and the spaces between the piers are likewise perfectly regular. Then (at the end of the 12 th century) the cath.

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cathedral of Sens was connected with the plan, that seemed to be adopted for the episcopal churches of the royal domain, in general arrangement, although it retained points of relations to the monuments of Champagne, and notably with the cathedral of Langres. <sup>1</sup> The place of the archbishop was at A, and that of the main altar at B. At the end of the 13<sup>th</sup> century, they began the construction of a transept gable wall b a. These works appear to have been long suspended, for only at the beginning, of the 16<sup>th</sup> century was that gable completed, and that at e f was erected at the North. <sup>2</sup> Then the bays g, h, of the old church were demolished, as well as the piers i, k, and they rebuilt the great vaults to cover these transepts found at the expense of the two old bays. It was probably at that epoch that the choir of the chapter was extended to the piers p, p; for when the transepts were scarcely marked by the two eastern chapels C, C, the clergy remained in the semicircle; the nave was left to the believers as far as the front of the altar.

Note 4.p.222. The portions of the plan modified during the 13<sup>th</sup>, 14<sup>th</sup> and 16<sup>th</sup> centuries are hatched.

Note 1.p.224. Art. Cothédrale, Figs. 28, 30.

Note 2.p.224. Art. Cothédrale, Fig. 30.

Evidently, the programme of the monastic churches relating to the transverse aisle, varied according to the orders, the provinces and the time; for in these monuments in France, we discover very different arrangements of transverse aisles, and especially in the provinces of the West the transverse aisles of abbey churches take an extraordinary relative development. In the abbey churches of S. Front of Périgueux (end of 10<sup>th</sup> century), the transverse aisle is equal in area to the nave and choir, i.e., the plan presents a cross termed Greek. <sup>1</sup> The transverse aisle of the abbey church of S. Hilary of Poitiers, that dates from the 11<sup>th</sup> century, was very large. A central nave and six side aisles abut against it. <sup>2</sup> The rare Benedictine churches rebuilt in the 13<sup>th</sup> century still occupy developed transverse aisles, though the new preaching and mendicant orders erected churches without transverse aisles. <sup>3</sup>

Note 3.p.224. At Notre dome of Poitiers, the sanctuary was originally on a level with its side aisle.

Note 4.p.224. See *Monographie de la cathédrale de Noyon*, by MM. Vitet & D. Ramee. Also *Arts. Architecture religieuse*, Figs.





30, 31; Cathedral, Figs. 7, 10.

Note 1.p.225. Art. Architecture religieuse., Fig. 4.

Note 2.p.225. The abbey church of S. Hilaire of Poitiers was dedicated in 1049. See Notes of a tour in the West of France. (Parker. London. 1852.).

Note 3.p.225. Art. Architecture monastique.

It is settled that the transverse aisles were regarded by the old orders and the Cisterians as necessary for the service of worship. Churches preceding the mendicant orders, simplest in the composition of the plans, all possess comparatively extended transverse aisles. We shall choose one more specimen among the last monuments erected with parsimony, the church of Obazine dependant on the abbey founded by S. Etienne of Obazine, and rebuilt in the 12 th century; the more because the plan of this edifice presents an arrangement very rare in France. (Fig. 7). Besides the sanctuary, 6 eastern chapels open into the transepts and that project much beyond the nave. The stairs communicate with the second story of the cloister buildings. The tomb of S. Etienne is placed at b. It is evident that this transverse aisle was reserved for the religious, and that the enclosure was placed at c c. Fig. 8 gives the section on e f of this transverse aisle, crowned by a tower over the crossing. Thus from the back of the choir the religious could ring the bells; they officiated at the chapels without leaving their enclosure, and the nave was only the place for the assembly of the believers, entirely independent of the parts reserved for the worship. The Cisterian churches present analogous arrangements, allowing the faithful to be present at the ceremonies without entering the enclosure.

It does not appear that in the 13 th century at least, the Benedictines adhered to retaining these claustral customs.

The plan of the abbey church of S. Denis will supply us with the proof, that either the example of the bishops, who had devoted the entire area of the new cathedrals to the believers ended in modifying the monastic rules, or that in presence of this liberal arrangement of the episcopate and perhaps also from the multitudes, that the preaching monks attracted in their vast churches open to all without enclosures, the Benedictines may have felt the necessity for no longer separating themselves from the believers, accustomed to circulate freely





in the churches; the religious of S. Denis always seem to have sought (when their church was in great part rebuilt about the middle of the 13<sup>th</sup> century) to attract a multitude of the public into their basilica by broad arrangements, very far removed from the claustral customs of the preceding centuries.

It was necessary to contend against the fashion, that led the people to those preaching monks, whose churches were only large lecture halls, and this certainly was not by maintaining those numerous obstacles, that in the Cluniac churches themselves obstructed the view and circulation, that one could hope to draw the multitude to the relics, whose prestige diminished daily. Thus it was no longer at the back of crypts that the shrines were preserved; they are placed in the sanctuaries and surrounded by precious objects. They are exhibited the more, that the people gradually lose the veneration paid to them. The pomp of ceremonies, the facilities afforded to believers to be present, replaced with the Benedictines the severe discipline previously maintained in their churches; with a lack of faith that slumbers or vacillates, they at least awake entirely.

Now the successive plans of S. Denis, so to speak, cause us to touch that modification in the relative customs of the great abbays. Thus they merit attentive study.

Here (Fig. 9) are those plans presented on each other, so that the excavations and the traces of structures still existing can make them recognized. We see at a the remains of the foundations of the apse and of the transverse aisle of Dagobert, built with the remains of Gallo-Roman monuments.<sup>1</sup> During the Carlovingian period, the church was greatly enlarged to b from the apse of Dagobert; <sup>2</sup> then were placed the structures of Suger, still visible above ground at c. Then the two descents to the older crypts were arranged at e; <sup>4</sup> the sanctuary developed widely above the cellars of the Carlovingian church, and one must ascend to it by stairs placed at g on both sides of the altar and at h.

Note 1.p.227. Hatchings from left to right indicate these remains.

Note 2.p.227. Wide hatchings from right to left indicate these structures still visible in the crypts.

Note 3.p.227. Close hatchings from right to left indicate these works.





Note A.p.227. These descents still exist.

The nave of the church of Suger was narrower than that of the existing church, as it is easy to recognize at the western entrance and by the excavations made at l. Then the transverse aisle of the abbey church of the 12 th century, furnished with a side aisle next the sanctuary, compressed the space m n o p. Th This side aisle A A was otherwise necessary to receive the steps that ascended to the sanctuary and those descending to the crypts.

These structures, partly established on the very badly built remains of the church of Dagobert, or on insufficient foundations, as it is easy to recognize, probably threatened ruin about the middle of the 13 th century. Either this reason may have determined, or that the edifice did not more perfectly respond to the needs of the time, and they resolved to rebuild almost entirely, and notably all parts of the transverse aisle, under the reign of S. Louis (1230 to 1240).

A vaulted cellar that entirely exists at f clearly shows that the wall i was external, since it has a raised window; the walls j and the back of the side aisle of the transverse aisle yet exist, and one finds at K the foundations, which indicate that the structures of Suger did not extend beyond the present gable walls.

These structures, partly established on the very badly built remains of the church of Dagobert, or on insufficient foundations, as it is easy to recognize, probably threatened ruin about the middle of the 13 th century. Either this reason may have determined, or that the edifice did not more perfectly respond to the needs of the time, and they resolved to rebuild almost entirely, and notably all parts of the transverse aisle, under the reign of S. Louis (1230 to 1240).

Our Fig. indicates in black all the structures rebuilt then. A glance at the plan causes to be understood the new importance given to the transverse aisle and the side aisles accompanying it. The nave was sensibly widened and harmonized with the sanctuary, whose spacings of piers were retained on the skew, which would appear very strange if one did not take into account the state of the earlier constructions, that it was claimed to preserve next the apse.

The piers B of the sanctuary were rebuilt anew, those at T





of the semicircle being on the bases of the 12 th century. Those at B were founded anew in the crypt, passing through the Carolingian vaults. Men were contented to rebuild on the old foundations the piers that rest on the angle of the Merovingian apse; but instead of the three bays D, only two were made, and the steps ascending to the sanctuary were transferred to E. Chapels were established at F at the level of the floor of the sanctuary. One of the doors of the old transverse aisle of Suger was placed at G.<sup>1</sup> S. Louis desired to rebuild anew the tombs of his predecessors. These tombs were placed at H, i.e., on the places that they had occupied in the preceding church. That of Dagobert rose at L, very probably on the spot where tradition had placed his interment.<sup>2</sup> Then the choir of the religious extended in the nave from the transverse aisle to the point M, and the public could circulate in the side aisles and cross the arms of the cross. Chapels were dedicated at N and P. Much later the last was occupied by the tomb of Francis I. In the 14 th century were erected other chapels along the north side aisle at K. The interments of the abbots filled the transept S.

Note 1.p.229. A similar operation was made at the cathedral of Paris, at those of Bourges and Chartres. The sculptures of the 12 th century were judged worthy of being preserved and were replaced in the structures of the 13 th.

Note 2.p.229. In excavating the entire centre of the transverse aisle, we found beneath the floor of the church of Dagobert numerous Merovingian sarcophagi. (Art. Tombeau, Fig. 1).

These superposed plans have this of interest, that they cause us to recognize the modifications made by time in the monastic customs of one of the most powerful abbeys of France. At first as in the primitive church, the very extensive transverse aisle, composed with the width of the nave, is made to contain and enclose the religious, who have no communication with the believers. Then under the Carolingians, while maintaining the arrangement of the primitive transverse aisle, they added to it a deep sanctuary, that formed as it were a second church suited for the exhibition of relics. Under Suger, this chapel is enlarged, equipped with numerous chapels and the transverse aisle opens more on the nave. Finally in the 13 th century, the monastic enclosure in the church is no longer absolute; the choir





of the religious is entirely surrounded by believers, who have access everywhere as in the cathedrals, except in the sanctuary occupied by the relics, and in the choir surrounded by the stalls, closed to the nave by the rood loft and by low grilles next the two transepts. One will observe, that in this particularly venerated church, what is least modified is the transverse aisle; until the last works undertaken, it remains in the same place. The altar also remains in the 13<sup>th</sup> century at V, over the point consecrated by tradition.<sup>1</sup> This transverse aisle is placed in communication with the buildings of the abbey by a wide doorway. It likewise opens on the external side into the old cemetery called of the Valois. Ample steps allowed the believers to circulate in the side aisle of the sanctuary and to be present at the offices in the chapels.

Note 1.p.230. To take into account the old arrangement of the transverse aisle, which formed a part of the choir of the religious of S. Denis, see Art. Choeur, Fig. 2. Today the monuments are established in the transverse aisle according to the arrangement adopted under S. Louis.

But if the transverse aisle has retained its position and nearly its primitive dimensions, it was no longer found in the 13<sup>th</sup> century in the conditions in which it was found in the 6<sup>th</sup> and even in the 12<sup>th</sup>. The church developed around it for the benefit of the attendants.

Yet these transformations were manifested only in the churches of the great abbeys, the small religious establishments retaining nearly the old arrangements of the transverse aisle reserved to the monks. The church of S. Jean-aux-Bois near Compiègne is an example of one of those monastic structures erected in the 13<sup>th</sup> century in small dimensions. Without side aisles, this church is composed of a wide nave and a sanctuary, separated by a transverse aisle with transepts each divided by a column on the extension of the lateral walls.<sup>2</sup> This pretty arrangement, so suitable for a small monastic church, is presented in a perspective view (Fig. 10). There is perceived in that Fig. the beam over the entrance to the sanctuary.<sup>3</sup> The stalls of the religious having their backs toward the transepts, and these behind the stalls leaving free spaces for guests or personages having access to the monastery. The nave was thus reserved for people from outside. They entered the transepts





only by little doors opening within the walls of the monastery.

Note 2.p.230. See the plans and elevations of this pretty edifice in the work of M. de Boudot; *Églises de bourgs et villages*. (Morel, éditeur).

Note 3.p.230. Art. Trobes.

The parish churches suffer the influence of the neighboring abbeys or cathedrals. From a distant epoch most of them possessed transverse aisles, principally in the provinces of the North, Centre and East. In Poitou, Saintonge and Angoumois, on the contrary, it is not rare to find parish churches of the 12th and 13th centuries without transverse aisles. The crossings of these parish churches habitually surmounted by towers in the provinces of Isle-de-France, Normandy, Burgundy and Auvergne. The transepts are either pierced by doors or closed, especially when they open into eastern chapels, so that persons entering or leaving cannot disturb the faithful. We have a beautiful example of these closed transepts of parish churches in the very remarkable church of Notre Dame of Dijon (Fig. 11). Here the gallery of the triforium stops to leave space for the rose window, simply furnished with an iron framework.<sup>1</sup> The passage beneath that rose window is supported by two small columns and three segmental arches.

Note 1.p.233. Art. Armature, Figs. 6, 7.

Another lower passage is found between these columns and the windows of the ground story. The chapel of the transept opens opposite the side aisle of the nave, that does not extend around the sanctuary, so that each of these transepts leaves a free and quiet place for the believers present at the offices said in these chapels. There is indeed an arrangement suitable for a parish church of small extent. The horizontal plan perfectly explains the happy composition of the transverse aisle of the parish church of Notre Dame of Dijon.

But this plan is interesting to study from another point of view. When one desires to know an architecture, it does not suffice to appreciate its style, to analyze its forms and practical means; it is necessary to discover the general principles, that have served to constitute it, to give it the homogeneity resulting from the use of a method. By pretending to study the architecture of the ancients independently of these primary laws, men have fallen into the gravest errors, and anarchy has





taken possession of their minds, even by the extent of those studies. It is true that we are sometimes told, that what we call anarchy or absence of method, is nothing but an inspiration full of promise, and that the art of the future will spring all armed some day, from the chaos of styles and forms adopted without criticism or examination. According to our feeling, this hope is only an illusion: for the works of the mind attain a development, only when based in a principle having all the rigor of a formula. When that basis is established, the artist gives himself up to inspiration, "if he has received from heaven the secret influence." That is for the best; but it is best to rest on the solid earth, to be able to rise.

When it is necessary to intersect the naves of a basilica by this transverse aisle and to cover the whole by carpentry, or indeed when rows of piers are destined to bear the tunnel vaults, drawing the transverse aisle did not present serious difficulties; it was otherwise when the French system of architecture with cross vaults was definitely adopted at the beginning of the 13th century; these drawings then demanded particularly attention. It was necessary to think of the thrusts acting in all directions; to relieve those spaces that required points of support the more solid, as they were larger; to combine the ends of the side aisles in that great transverse nave so that their arrangement accorded with the transepts; to think of the returns of the upper galleries, of a lighting in relation to the extent of the transverse aisle; to proportion the dimensions of the choir to that of the transverse aisle; to decide either for eastern chapels next the transepts, or the continuance of the side aisle around the choir, etc.

To fulfil such diverse conditions, when one has for all method only his own inspiration, or a vague memory of what has been done in that kind before us, and it is necessary to take up the pencil and compasses, we frankly admit that one scarcely knows where to commence, and that one can arrive at a result nearly satisfactory only after long experiments; also he does not have a very tranquil mind, and may fear that this inspiration behind which so many vague minds shelter themselves may have failed at some point.

Now if we take the plans of churches of that epoch, we recognize that the methods of drawing them generally adopted, and





not without reason, are followed with still more attention, when it is necessary to lay out transverse aisles.

We shall choose as an example of a method of drawing the plan of the transept of Notre Dame of Dijon. (Fig. 12).

Let  $E$  be a scale of 6 toises (33.4 ft.). The entire portion of the church with the transept to the apse is comprised in an equilateral triangle, whose half is  $a b c$ . The sides of this equilateral triangle are each 14 toises (39.5 ft.); then the half  $a b$  is 7 toises (45.8 ft.). According to the necessity imposed by the system of vaulted architecture, the tracing of the vaults determines the tracing of the piers. The thickness of the wall  $b' c'$  of the transept being fixed at 3.2 ft., the line  $a b$  after deducting this thickness was divided into 3 equal parts; the first division line giving the axis  $p$  of the piers of the nave; and the second the axis of the pier at the angle of the transept. The drawing of the piers was decided on as at  $A$  for the great piers, and at  $B$  for those of the nave. It is well understood (Art. Trait), that these drawings of piers result from the form and dimensions of the arches of the vaults, that are fixed by the spans of those arches. The pier being known, one fourth being sketched at  $A$ , nothing more is necessary than to place the axial line of this pier on the axis  $p$  of the division, according to the case, as we shall see.

The thickness of the wall of the apse being fixed at 3.2 ft., they at first claimed to make the spans  $g h$ ,  $h i$ ,  $i j$ ,  $j k$ ,  $e$  equal for the side arches of the apsidal vaults. To do this, the half  $l j$  of the decagon was drawn so that the radii  $i' o$  may equal the half  $o p$  of the nave after deducting the thickness  $r s$  (see detail  $A$ ), the little column  $r'$  being intended for the low arcade and for the side arch of the high vault. Then from  $j$  to  $k$  was laid off a distance equal to  $i j$ . This point  $k$  being known, the template of the pier  $A$  is presented, the point  $k$  being the centre of the little column  $r'$ , the axis  $s$  being always on the axis  $p$ . Thus one had the axis of the transverse arch  $g$ . On the base  $a b$  at its intersection with the axis  $p$  was presented the pattern of the pier  $A$ . It remained to determine the position of the axis  $t$ . Now the distance of that axis from the base  $a b$  equals the distance of that base from the axis  $V$  from a transverse arch of a bay of the nave, a bay longer than its width by several inches; i.e.  $t u$  equals  $u v$ .





The rest of the layout naturally follows. The distance t q is less than t u, which was the result of that mode of drawing, and which also gives a better proportion, than if those distances had been equal, for then the choir would have seemed too deep for the transverse aisle.

Another monument of the same epoch (1230 to 1240) and of the same provenance presents a very remarkable arrangement of the transverse aisle, the church of Notre Dame of Semur. But at Semur the side aisle continuing around the choir, the architect has established chapels parallel to the straight portions of that side aisle, so as to leave (the nave being very narrow) the necessary space for the believers on feast days. <sup>1</sup> it is rare to find in our parish or collegiate churches of Isle-de-France, Champagne, Picardy and Normandy, arrangements as broad and well adapted to the service. In the last provinces, the transverse aisles of the parish churches of the 12 th and the beginning of the 13 th centuries are of small extent, encumbered by thick piers compared to the voids, and only in 1250 these religious edifices of the second order assumed amplitude.

Note 1.p.236. Archives des monuments historiques. See the plans and sections of this edifice.

By compensation, the arrangements of the transverse aisles of our cathedrals of the North, that are provided with them, like Laon, Rheims, Amiens, Chartres, are drawn with a breadth and an understanding of the great public assemblages, that leaves nothing to desire. (Art. Cathedrale, see the plans of those edifices). Abundantly lighted by the rose windows opened in the gable walls of the transepts and by opened galleries, giving entrance from the choir into the double side aisles, most frequently pierced by doors on the public streets, these transverse aisles of our great cathedrals are the most beautiful arrangement ever adopted to gather at one point a great multitude of people. Hence the 14 th and 15 th centuries made no change in these arrangements.

Double transverse aisles with double apses, one at the east and the other at the west, very frequently adopted by the Rhenish school during the Romanesque period and until the 12 th century, are found in France only in the provinces of the East. The cathedrals of Verdun and of Besancon possessed double transverse aisles with towers in the reentrant angles of the apses,



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these not being surrounded by side aisles. (Art. Architecture religieuse, Fig. 39; also see plan of the abbey of S. Gall; Art. Architecture monastique, Fig. 1).

In France, many of our abbey churches of the North had towers erected over the transepts. This arrangement exists at Notre Dame of Rheims, Chartres, the abbey churches of S. Denis, Cluny, Vezelay, etc. Sometimes vast porches open on the ends of the transepts, but this system so frankly adopted at the cathedral of Chartres, is later by some years than the erection of the transept. After the disastrous wars against the Albigenses, no most of the churches rebuilt in Languedoc were erected without transepts. Such is the cathedral of Alby. The churches of the new city of Carcassonne, those of Montpezat, Moissac, etc., consist only of a nave with chapels. Indeed the construction of a transverse aisle required considerable expense, and if men claimed to erect a church with weak resources, it was necessary to avoid appendages.

It is rare to find in churches later than 1250 new arrangements in the construction of transverse aisles. Yet one church in Champagne forms an exception, S. Urbain of Troyes. Its transverse aisle is very ingeniously conceived, and entirely satisfies the programme of the parish church.<sup>1</sup> Two porches at the end of each transept shelter double doorways, and in the interior the vaults of these transepts are drawn on a new principle.

Note 1.p.237. See the plan of this church in Art. Construction, fig. 102.

The internal view (Fig. 13) of one of these transepts explains the original arrangement of this transept. Divided by a perforated tracery in the gable, by two windows opened over the external porch and by two other windows in the lateral walls above the side aisle of the nave and the chapel and flanks the choir, each of those transepts is a veritable lantern in its upper part. The appearance of the transept of S. Urbain is impressive. The architect knew how to avoid the poverty of the insides of the gable walls usually lighted by rose windows over solid walls only pierced by doors in the ground story. This system seems to us preferable to that adopted in some edifices, such as the cathedrals of Metz and of Soissons,<sup>2</sup> the church of Moret, etc., and that consists in replacing the rose windows by vast glass windows opening beneath the side arches of the





gables and descending to the archivolts of the doorways,<sup>3</sup> or to regard the rose windows themselves with the open gallery supporting them, as actual windows comprising the entire width of the transept. But it must be added that the church of S. Urbain of Troyes is a masterpiece, whether one considers the general conception or the harmony of the details.

NOTE 2.p.237. North transept.

NOTE 3.p.237. Art. Pignon.

Very rarely do the transverse aisles of the church of the middle ages possess galleries inside the gable walls of the transepts; and when they exist, as at the cathedral of Laon and in the church of Eu, for example, those works date from an epoch later than that of the primitive construction of the edifice.

One must also regard as an exception the porches of transepts surmounted by a tower. The south transept of the cathedral of Mans furnishes us with an example dating from the end of the 13<sup>th</sup> century.

#### TRAVAILSON. Wooden Entablature.

An old word corresponding to what is now understood by entablature; but applied only to works in wood.

#### TRAVERSE. Bay.

A word employed to designate any arrangement between the principal points of support or the chief parts of the structure; thus is said the bay of a floor to indicate the joists comprised between two girders. Bay of a bridge is the part of the wooden floor comprised between two lines of piers or between two piers. Bay of a hall or church is the arrangement comprised between two main piers or two transverse arches. Bay of a roof is the space between two carpentry trusses.

From the moment that the hall is divided by points of support spaced lengthwise to support a vault, trusses or girders, that hall is composed of as many bays as it contains divisions.

In the construction of the middle ages in France, the history of the bay is interesting, because it determines the successive attempts by which, from the Roman basilica covered by carpentry, men arrived at the nave covered by cross vaults.

No one is ignorant, that the Roman basilica was generally composed of a principal nave, whose walls rested on rows of col-





columns, flanked laterally by single or double side aisles. The side aisles were sometimes surmounted by galleries or tribunes, above which were opened windows that lighted the ceiled carpentry. This arrangement was followed in the construction of the first churches and great assembly halls erected in Gaul. Each intercolumniation of the basilica formed a bay.

The plan of the Roman basilica was followed in the North of Gaul until about the middle of the 11<sup>th</sup> century; but already before that epoch, the mode of construction had suffered modifications because of frequent relations of the western peoples with the Orient. The most ancient monument of that time which we possess in considerable dimensions in southern France is certainly the nave of the abbey church of S. Remi of Rheims. It is still easy to recognize, that this nave was originally covered by visible carpentry, while the side aisles, vaulted in the ground story, were surmounted by a gallery covered by carpentry with transverse arches. Fig. 1 gives one bay of the nave of the abbey church of S. Remi.<sup>1</sup> The great wall A rests on a row of piers composed of clustered columns in the ground story, over these being piers of rectangular section to the level of the gallery of the second story. Columns with arches divide the openings on that gallery. Above the roofs of the side aisles open two rows of windows B and C. The vaults of the side aisles in the great story consist of transverse arches D and F supporting tunnel vaults perpendicular to the nave and concentric with the archivolts E. The little piers G form a second narrow side aisle, for the purpose of diminishing the thrust that a single transverse arch would exert on the enclosing wall H. In the second story the transverse arch I bears only a wooden floor, and could not exert on the wall H a thrust, that this wall reinforced by cylindrical buttresses cannot resist. The great wall A found itself shored by those tunnel vaults of the ground story and by the transverse arches of the gallery. It was only decorated by paintings, according to the custom of the time.<sup>1</sup>

Note 1.p.239. See a part of the plan of this nave in Art. Tr. Transept, Fig. 2.

Note 1.p.241. In the 12<sup>th</sup> century, vaults having been constructed over that nave, resting on little columns attached to the piers with much skill, Flying buttresses must abut them. T





The tunnel vaults of the side aisles were destroyed as well as the little pillars G, and cross vaults replaced them. Yet the arrangement of tunnel vaults perpendicular to the walls was retained in the transept. These works could only change the stability of the edifice built of materials of small dimensions; so much that (some years since) it was necessary to rebuild the high vaults in light materials and to restore the lower parts. These works unfortunately have caused the disappearance of the various traces of the primitive arrangement. Yet one still sees at several points the impost S of the transverse arches of the primitive side aisles.

This example of a nave built at the beginning of the 11th century indicates a first effort to leave the system of the antique Roman basilica. Clusters of little columns replace the single columns, and vaults already bear the floor of the upper gallery. Yet these great walls not being connected in their extent, except at the top by the tiebeams of the carpentry; they were not constructed with the excellent materials and mortar employed by the Romans; they frequently buckled or leaned to one or the other side. Their appearance did not fail to be cold, and the paintings ornamenting them being seen obliquely, dusty in time, soon lost their splendor. The carpentry at that height could only be repaired with difficulty, and if it caught fire, the entire edifice was lost. They then thought of frankly dividing the naves in visible bays, accented by great transverse arches. Another edifice of the middle of the 11th century furnishes us with an example of this new system. This is the church of Notre Dame du Pre at Mans. In the nave of that edifice each bay comprises two arches (Fig. 2). A great pier of rectangular section, flanked by engaged columns, alternates with a cylindrical pier. At each of the great piers A is turned a transverse arch B. A carpentry truss is placed at the cylindrical pier C. The side aisles are covered by cross vaults with transverse arches resting on the engaged columns of the great piers and on the capitals of the cylindrical piers. The rafters of the carpentry are placed lengthwise like joists, and rest on the gables of the great transverse arches B and on the intermediate trusses. Those timbers are more or less decorated, having plank interjoists, forming a ceiling under the roofing. At F is represented one of the gables of the great transverse





arches with the ceiling.<sup>1</sup> There is every reason to admit that the nave of the cathedral of Mans was originally built on this principle. At Notre Dame du Pre, vaults were rebuilt in the 14th century under the old carpentry, suppressing a part of the primitive transverse arches, whose traces are easily found. Thus taking two arches of the nave to make one bay, there results a plan, square or approximately so, i.e., the space A A was equal or nearly so to the width of the principal nave; so that if one desired to definitely vault this nave it was entirely simple to adopt at first a vault on a square plan with an intermediate transverse arch; i.e., a vault giving in horizontal projection the plan sketched at P (Fig. 2; hexapartite). Then the transverse arches a b, c d, were only the reproduction of the transverse arches of the great piers, and the intermediate transverse arch e f replaced the carpentry truss; the diagonal arches a d, c b, supported the compartments of the vaults turned in the place occupied by the ceiling. But before passing beyond the examination of the developments of this principle, it is necessary to mention a system of bays resulting from another method of construction.

The Romans had not only adopted for the construction of great halls the system of rows of columns supporting walls over lintels relieved by arches sunk in thick walls; they had erected on isolated piers those widely spaces, great archivolts bearing the longitudinal walls. Tunnel vaults were concentric with these archivolts and covered the side aisles, the carpentry of vaults (as at the basilica of Constantine at Rome) covered the principal nave. The late empire had built edifices in great number after this system, sometimes retaining the carpentry on the central aisle, as proved by certain basilicas of southern Syria. From that system was derived after the first centuries of Christianity a mixed mode, which consisted in dividing the great square bays into two arches, supporting cross vaults over the side aisles, whose widths were nearly equal to half that of the principal aisle. On this plan was conceived at Milan the celebrated church of S. Ambrose, after the end of the 9th century; at least the fact seems probable.<sup>1</sup> Now this type was adopted in the construction of a great number of Carlovingian churches, notably on the banks of the Rhine, and was continued until the 13th century.





Note 1.p.242. This arrangement was adopted in the church of S. Miniato near Florence; it was quite common in the middle of the 11 th century in our northern provinces, and notably in Champagne.

Note 1.p.243. On this subject see Etude sur l'architecture lombarde by M. de Bertein, engineer of bridges and roads. However, if we do not contest the age of the arrangement of the plan of the church of S. Ambrose of Milan, it seems to us that the author of that excellent work in the notice that he gives of that church, does not sufficiently take into account the restorations, that it had to suffer, and that he depends on the texts in too absolute a manner. For example, how many edifices do we not have in France, whose nearly total reconstruction is only mentioned incidentally, or not at all! No text mentions the reconstruction of the facade of Notre Dame of Paris, among others; is it necessary to conclude that this facade is that of Etienne of Garlande in 1140, or dates from the episcopate of Maurice de Sully (1160 - 1190)? After the great disaster of 1119, i.e., after the ruin of the vaults of the church of S. A Ambrose of Milan, that monument must suffer an almost total rebuilding. Vaults do not fall without a cause; such a great disaster is generally the result of a leaning of the piers; now the existing piers of S. Ambrose do not appear to have suffered alterations of a nature to have caused the fall of the greater vaults. From the examination which we made of this edifice a few years since, it results that we could not assign to its date the date of the 9 th century (not including the vaults). The mouldings, the sculptures and all the upper parts, even the construction of those parts, seem to belong to the 12 th century, a brilliant epoch for art in Lombardy as in France. Monuments erected on the soil of north Italy, and whose Carolingian date cannot be debated, have a barbarous character in construction, that is not found in S. Ambrose of Milan. Yet, we repeat and indeed believe, like M. de Bertein, that the arrangement of the plan belongs to the 9 th century, as well as a part of the lower structures, the altar, etc.

As in the example just given (Fig. 2), each bay of the Carolingian church of the Rhine consists of two great piers and an intermediate pier of smaller section; but this intermediate pier bears only the transverse arch of the vaults of the side





aisle and fulfils no function next the principal nave. The bay that we present here (Fig. 3) of the nave of the cathedral of Worms, a nave that dates from the middle of the 12 th century, sufficiently explains this system. A great square cross vault A with ribs covers each bay of the nave without an intermediate transverse arch; and the pier B is placed there only to obtain two Roman cross vaults over the side aisle. The question was to have square areas, or approximately so, in covering the vaults, that is always derived from the Roman tradition; now the side aisles having a width of about half the width of the nave, it was necessary to double the piers in order to have square areas in the side aisles as in the nave. The sketch T relieves us from long explanations of this matter. The necessity of vaulting great edifices, basilicas and churches, was recognized everywhere in the West, both in north Italy and France and also on the banks of the Rhine; yet the different schools of art in those countries did not solve the problem in the same fashion. To consider matters in only a general manner, the school that we term Carolingian, and which was chiefly inspired by the Roman architecture of the late time, had in view only the Roman vault, tunnel, cross or dome; that school abandoned that tradition only when it adopted the system of construction imported from France about the middle of the 13 th century. The French school proper on the contrary, abandoned early the system of Roman vaults, sought and found something else; all is there. If one discovers in Lombardy or elsewhere square piers with engaged columns and archivolts in the aisles, some details of decoration analogous to, or preceding our French Romanesque architecture, and one concludes from this that we have taken from others this Romanesque architecture, we do not see that great interest attaches to that priority. Each drew from the common Latin stock for the arts as for the languages of the West from the 8 th to the 11 th centuries; but if one shows elsewhere than in France, and north of the Loire before 1130 a system of vaults, like that adopted in the structures of Vezelay after the beginning of the 12 th century, and at S. Denis in 1140, then we shall be the first to recognize what it is desired to prove to us in France, viz:- that we have never possessed a native architecture, no more in the 12 th than in the 19 th centuries.





Until this proof is made, we shall continue to repeat; there is no original architecture except that based on a new principle, one not before accepted. The system of vaults introduced in France north of the Loire from 1120 to 1150 is found nowhere before that epoch; this system is not merely a form, then novel or a procedure; it is entirely a principle that extends to the different parts constituting an edifice, and that compels the coordination of those parts according to certain laws deduced logically; then the architecture introduced in France from 1120 to 1150 was truly new then and without precedents, independent of forms accepted until then; thus this architecture can be termed French for the best reason.<sup>1</sup> Leave for the moment the system of Rhenish naves, and resume the study of edifices belonging to our schools. We have just seen (Fig. 2) a bay composed of two great piers bearing transverse arches over the principal nave, with a weaker intermediate pier, dividing the side aisle to be able to cover it by square vaults, and supporting a carpentry truss over that principal aisle to diminish the span of the wooden ceiling. Let us see how a system later than that of Fig. 2, belonging to another province, where the piers are equal and divide the side aisle in vaults on square plans, giving on the central nave rectangular plans, that men have claimed to vault according to a principle already entirely foreign to the Roman system. This refers to the nave of the abbey church of Vezelay (Fig. 4); the first years of the 12th century. This nave, one bay of which we give at A, possesses transverse arches over the side aisles as over the high portion, at each pier of section drawn at B. Those arches are round like the side arches, and although the imposts of the latter are stilted, yet their crowns do not reach the crown of the transverse arches. It results from this that to turn the high vault in each bay and not cause penetrations, but an appearance of a cross vault, it was necessary to experiment and to seek ellipsoidal forms, that could not be drawn geometrically. This was a first attempt toward a form of vaults not yet accepted. Thirty years later and about 1132 was erected the porch of the same church (see at P, Fig. 4); the bays of this narthex, a little wider than those of the nave, rest on piers with sections similar to those at B. Just as in the nave, transverse arches are turned at each pier, both on the central part and on the





side arches have their imposts at the same level as those of the transverse arches. It results from this, that the bay being rectangular, the crowns of these side arches are much below the crowns of these transverse arches. The vault covering this space is annular from one transverse arch to the other, penetrated by ellipsoids, and <sup>or</sup> which the side arches are sections. That could be defined geometrically, and this system presents a perfect stability. Besides, rampant cross vaults are turned over the galleries of the second story <sup>2</sup> and perfectly abut to the central vault. Two of the vaults of this porch, of the same epoch as the others, already possess pointed arches. The constructor in closing these vaults according to the method just indicated (Fig. 4, P) indeed felt that while approaching an ellipsoidal body, yet they possessed convex groins (these vaults being built of irregular rubble) maintained only by the adhesion of the mortar; that consequently he had to turn beneath those groins the permanent arches of stone, replacing the temporary centres of carpentry intended for setting them. That was an advance toward the pointed cross vault. But returning to our Fig. 2, in other provinces men derived from this mixed system of arches and wooden ceilings a complete system of vaults on an entirely novel principle, a method that must soon unite with that introduced in the porch of the apsey church of Vezelay. In 1150 bishop Baudoin II, it is stated, undertook the rebuilding of the cathedral of Noyon, that was completed before the end of the 12<sup>th</sup> century. In 1293 a violent conflagration reduced to ashes the city and cathedral of Noyon, according to the chronicle. It is clear that only the carpentry was burned and that the vaults were perhaps altered. Thus the vaults of the nave, as indicated by the profiles of the arches and their style of construction, belong to the last epoch. At the origin, i.e., in the 12<sup>th</sup> century those vaults, like many others dating from that epoch had their pointed arches turned between alternate piers with a simple intermediate transverse arch. (Fig. 5). The intermediate pier in Fig. 2 only supports the carpentry truss bisecting the space between the transverse arches, but then separated the transverse arch intended to replace the carpentry truss. The diagonal arches (Fig. 5) were turned from one great pier to another. The bay was also constructed like that of Fig. 2. I. e., the intermediate pier A,





intended to bear a simple transverse arch of the great vaults, was more slender than the piers B supporting the principal transverse and diagonal arches. That was according to logic. Then the arches resting on the piers B alone were abutted by flying buttresses. The section C of the nave and of the side aisles completes the knowledge of that system of construction. Most of the first vaults built on this principle adopted in the 12th century, are so drawn in Isle-de-France. The bay of the central nave is equal, or very nearly so, to the width of the same nave, but it is dissected by means of an intermediate pier, that serves to bear the arches of the vaults of the side aisle and to intersect the diagonal arches of the high vaults.

Note 1.p.246. M. Vitet wrote thus in 1845:-- "Let all those that these questions inspire with a serious interest, cease to attempt to prove, some that the pointed arch come to us from the Orient, others that it is indigenous; what empty and idle quarrels! Let them seek who put into execution the pointed system, why the influence of that system has been so great and so universal, how that during three centuries it exercised over half Europe an absolute sovereignty; finally, let them seek if the birth and progress of that system are not inseparably connected with the regeneration of modern society, the first germs of which the 12th century saw unfold. Architectural revolutions thus examined are no longer confounded with those futile and ephemeral fancies, that prefer a certain material to any other for a certain time; they are serious, veritable revolutions, and express ideas." *Monographie de Notre Dame de Noyon*. p.130.

Note 1.p.248. Art. Construction, Fig. 19. Section of this porch. Arts. Porche and Ogive, Figs. 3, 4, 5.

Note 2.p.248. See the section.

But this system, justified by such a vast structure, was scarcely admissible for small edifices. The intermediate piers in the latter monuments would have been too slender, useless and encumbering. The architects suppressed them, retained only the principal piers A (Fig. 6), but still constructed the vaults according to the principle just indicated. This last bay belongs to the little church of Nesle near Isle-Adam, and shows how the constructor has only erected the pier intended to support the intermediate transverse arch on the crown of the archivolt of the side aisle,<sup>1</sup> because it was useless in fact to rest that





intermediate pier on the ground. At B is drawn the section of that bay, and at D is the detail of the bases of the little columns on the capitals of the cylindrical piers. These two examples belong to two edifices of very different dimensions, but erected at nearly the same epoch, and emphasize one of the principal qualities of that beautiful French architecture of the end of the 12<sup>th</sup> century, the unity of scale.<sup>2</sup> The spacing of the piers, height of the galleries of passage C, widths of the bays, members of the mouldings, are nearly the same in the two monuments. We can perceive these analogies in the cathedrals of Paris, Senlis, Soissons and Laon, in the churches of S. Leu d'Esserent, of Braisne, etc.<sup>3</sup> Let us now examine a bay of the nave of one of the largest monuments of the beginning of the 13<sup>th</sup> century, the cathedral of Bourges.<sup>4</sup> This interior comprises a central nave and double side aisles with vaults at different levels. Thus (Fig. 7) the vaults of the first side aisle are turned at the level A, and those of the second side aisle at the level B, from which it results that the central nave is lighted by the windows C, pierced above the roof covering the vaults of the second side aisle. In the height of this roof extends a gallery for passage D, just as there exists a second at E, above the vaults of the first side aisle. These vaults are constructed according to the system previously described; and one will observe that the piers G, which bear only the transverse arches of the intersection are less in diameter than those at H, that bear the transverse and diagonal arches.

Note 1.p.250. The construction of the church of Nesle dates from about 1175. This edifice is contemporaneous with the cathedral of Senlis and the abbey church of S. Leu d'Esserent.

Note 2.p.250. Art. Echelle.

Note 3.p.250. Art. Cathedrale, Fig. 4, one bay of Notre Dame of Paris.

Note 4. Art. Cathedrale, Fig. 6, plan of that church; Art. Proportion, Fig. 7, its section.

The beautiful arrangement of the nave of the cathedral of Bourges with its very high first side aisle, an arrangement scarcely repeated in France except around the choir of the cathedral of Mans,<sup>1</sup> is evidently inspired by the churches of Poitou. It is a compromise between the systems of construction of the naves of that province and of Ile-de-France. The central





nave of the cathedral of Bourges receives light in its upper part above the roofs of the side aisles, like the naves of our churches of Ile-de-France, which did not occur in the cathedral of Poitiers; but the inner side aisle beneath its vaults includes a considerable height, and is no longer equal in height to the second side aisle, as at Notre Dame of Paris, around the choir of Notre Dame of Chartres, and Cologne.

Note 1.p.253. Art. Gothedrale, Fig. 35.

In fact here is one bay of the nave of the cathedral of Poitiers, whose construction was a little earlier than that of the cathedral of Bourges, otherwise conforms to the Romanesque traditions of Poitou and Vendee, and accents the importance of the side aisle in these edifices. <sup>2</sup> Our Fig. 3 assumes at A the section made on the longitudinal axis of the side aisle, and at B on the axis of the central nave. The vaults of the side aisles are abutted by close flying buttresses and abut the high vaults. These side aisles are each nearly equal in width to the nave, so that this interior is rather a great hall with three aisles, than a church following the tradition of the transformed basilica. The arcade supports at the level C a sort of balcony, or continuous gallery, that passes behind each pier in the thickness of the buttresses. A single roof in two slopes covers the nave and its side aisles. This structure was built with much care and is remarkable for its beautiful proportions and the happy concord of all its parts. The vaults are drawn according to the method of Poitou and of Anjou, and partake of the dome and of the cross vault. (Art. Voute). In this composition is an emplitude, reason and sobriety, that are the true marks of power in the artist. This mixture of superior qualities, too rare today, is found in the composition of the bays of naves vaulted from 1150 to 1250, whether these interiors were destined for religious or civil uses. After the design of the transverse section, in fact the bay determines the proportions and appearance of an interior, with or without side aisles. Now those wide bays of the monuments of Poitou, Anjou, Maine and Angoumois, are surprising by their grand arrangement, although most of these structures are of mediocre dimensions. To appear great is certainly a quality for an interior destined to contain a multitude. One finds himself at his ease, even when space is materially lacking. The cathedral of Poitiers is of





mediocre dimensions,<sup>1</sup> and still by the beautiful arrangement of its wide bays, the impression left by it is that of a very vast interior.

Note 1.p.253. Art. Cathedrale, Fig. 35.

Note 2.p.253. Art. Cathedrale, Figs. 44, 45; plan and transverse section of the cathedral of Poitiers.

Note 1.p.254. Art. Cathedrale, Fig. 44. See its plan.

Certain churches of the same provinces, of Maine and Anjou, consist of interiors with a single aisle, and there again the composition of the bays is broadly understood. Among others, we shall cite the nave of the abbey church of Notre Dame de la Couliere at Mans (end of 12 th century), divided in bays of square plan with raised balcony, as at the cathedral of Poitiers, supported on great relieving arches of beautiful effect.<sup>1</sup> Here (Fig. 9) is one bay of that nave, without the side aisles. One need not be an architect to comprehend the system, from which can be derived this grand and simple arrangement, lending itself to all modes of construction.<sup>1</sup> The influence of this system of wide vaulted bays, single or with side aisles almost equal to the central nave, scarcely extends from Maine and Berry to the North; and as we have just stated, one can find a last memorial of it in the composition of the bays of the cathedral of Bourges. On this side of the Loire, the system indicated in the examples that we have given (Figs. 5 and 6) persists during the 13 th century, but except in very rare cases, men abandoned then the system of vaults with intermediate transverse arches, intersecting the diagonal arches, i.e., instead of being double, the bays are single and each has its own vault. Is it not evident that there pervades in these conceptions of bays during the period between 1130 and 1230 a freedom, whose value and extent cannot be ignored? No other architecture lent itself to forms and appearances so varied without abandoning the principles that directed it. Now is not that flexibility the result of the system of construction adopted? And since this system of construction harmonizes itself with liberty and leads to it, is it necessary to conclude that this architecture is nothing but a superannuated procedure, having no application today? Will not the attentive study of proportions be emphasized by the different examples, that have just passed under the eyes of our readers?





Note 1.p.255. An analogous arrangement exists in the nave of the abbey church of S. Rodegonde at Poitiers, and existed in the 12<sup>th</sup> century in the nave of the cathedral of Bordeaux.

Note 1.p.256. At A is sketched the plan of the pier with the passage at the level c.

Dating from about 1220, the bay of naves with side aisles in the edifices of the North is determined in a more precise manner. The piers are equal in thickness, and each bears the complete ribs of the cross vaults, upper and lower: the walls between those vaults are opened widely, and are even replaced by windows, that occupy the entire surface between the piers and side arches. According to this principle is conceived the nave of the cathedral of Amiens, built between 1220 and 1230.<sup>2</sup> We give (Fig. 10) a bay of that nave, that is no less than 139.4 ft. under the crown. The plan of the piers at the level of the ground story is sketched at D, and at the level of the gallery (triforium) at C. That gallery is closed by a thin wall M, attached to which is the shed roof that covers the side aisle. One sees at G the window of the side aisle, that erected on an arcade and a supporting wall comprises the entire surface existing between the engaged piers and the side arch. The same system for the upper windows F. They soon desired to suppress even the solid wall forming the triforium behind the roof of the side aisle;<sup>4</sup> the thin walls M were perforated, and the roofs covering the side aisles were placed as hip roofs over each lower vault, with gutters on the flying buttresses. Then the upper window was joined to the triforium, and the tracery extended down into the gallery. According to this principle was rebuilt in 1240 the nave of the abbey church of S. Denis, the choir of the cathedrals of Troyes and of Beauvais, and a little later (about 1260) that of the cathedral of Sees, of which we sketch one bay at A (Fig. 11)!<sup>4</sup> The floor of the choir is at the level B and that of the side aisle at C. The gallery (triforium) under the high window is perforated up to the height of a sill D, behind which passes the gutter. The lower tracery of that gallery does not reproduce exactly the design of the front arcade (Art. Triforium). As at the cathedral of Amiens, all the spaces left between the piers beneath the vaults are filled by windows decorated by stained glass; thus these bays present a considerable area of translucent painting





with the most brilliant effect. At O is given the section of a pier of oval plan, in order to leave to the voids the largest possible areas. Always according to these principles was constructed in the 14<sup>th</sup> century the nave of the abbey church of S. Ouen at Rouen (Fig. 11), one bay of which is presented at R.

Note 3.p.245. Because of the lack of space and to retain the same scale as that of the preceding (1 : 200), our Fig. divides the bay into two parts. The port F surmounts the port A in execution.

Note 4.p.256. Art. Architecture religieuse, fig. 36.

Note 1.p.259. Bay of the parallel ports of the choir.

These three last examples show how the masters of works tended to diminish the solids and increase the areas of glass in vaulted churches. This principle was scarcely modified until the 16<sup>th</sup> century; the portions of the cathedrals of Auxerre, Troyes, Sens and Beauvais, that date from the 15<sup>th</sup> and 16<sup>th</sup> centuries, reproduce except in details the system, that we see adopted in the 14<sup>th</sup> century at S. Ouen of Rouen. Besides, this system perfectly suits in our climate very great interiors. By the colored or grisaille glass, the effect of the rays of the sun was lessened, and yet a warm and soft light penetrated everywhere, that left no point dark. The distribution of the light in the great covered and enclosed spaces is a difficulty, against which the merit of our modern architects is injured. Thus most of the great halls built in our time have a cold and gloomy appearance. Large obscure places on the walls or the floor cut up those interiors, dwarf them to the eyes and do not lend themselves to decoration. Even the multitude scattered in those halls forms black spots with a disagreeable aspect. On the contrary, in the midst of these old edifices entirely opened between the principal members of the structure, there circulates a sort of luminous and colored atmosphere, which satisfies the eyes as well as the mind. One finds at ease in these vast frames that partake of the external light while softening it. It is to this judicious introduction of luminous rays, that these interiors may appear much larger than they really are. Thus the abbey church of S. Ouen, that is really of very ordinary dimensions, <sup>2</sup> seems to rival our great cathedrals.

Note 2.p.259. Art. Architecture religieuse, fig. 62.

An account is rendered of the arrangement of bays of the halls





of palaces and castles by referring to Arts. Construction, Palais, Salle.

#### TREFOIL. Trefoil.

Name given to an architectural member of geometrical form obtained by means of three circles, whose centres are placed at the vertices of an equilateral triangle. We also say trilobed (Fig. 1). From the end of the 12 th to the 16 th centuries, this figure was much used in the composition of tracery, rose windows, arcades, and generally in openings. Sometimes the points of intersection of the circles are terminated by a leaf ornament, A, by a human or animal head.

It often occurs that a trefoil encloses three other trefoils, as indicated by the sketch B. (Arts. Balustrade, Meneau, Rose).

Some authors have desired to see a symbol in that figure. Nothing supports that opinion. The trefoil quite naturally results from the very frequent use of the equilateral triangle in the architecture of the middle ages as a generating figure. (Art. Proportion). It had the advantage, for example, for the openings of tracery, of being easily inscribed within an equilateral arch a b of the figures produced by the equilateral triangle.

#### TREILLAGE. Lattice-Work. Trellis.

An opening composed of laths or slight peeces of wood connected together during the middle ages by nails or wooden pins; th then about the end of the 15 th century by iron wire.

Already about the end of the 12 th century, trellises were established in private gardens, and under S. Louis this mode of forming tunnel ceilings with vines was very common. At that epoch the trellises of the garden of the palace on the site of the present place Dauphine were in great reputation. Trellises then generally consisted, if one can refer to the vignettes of manuscripts, of crossed flexible strips of wood held by nails or willow ties sometimes interlaced. The fashion of latticed architecture does not appear to date before the beginning of the 16 th century. This was an Italian importation, and not one of the happiest.

#### TREILLES. Grating. Grille.





## TRELLIS. Grating. Grille. Lattice.

A closure of light iron bars, very close, a sort of grille (Art. Grille), but capable of opposing a serious resistance. It is frequently a question in the romances of the 13<sup>th</sup> and 14<sup>th</sup> centuries, of windows so latticed externally in a permanent manner (Art. Grille). Thus the name of trellis was given to grilles in the form of fences to defend the counterscarp of the ditches of castles. "All around Plessis, he (Louis XII) caused to be built a fence of great bars of iron, planting in the wall iron spits with several points, as at the entrance whereby one could enter the ditches of the said Plessis." <sup>1</sup>

Note 1. p. 261. Mem. de Philippe de Commines. Book VI. Chap. 7.

## TREASOR. Treasury.

A room reserved beside abbey churches and cathedrals, also in castles, to contain the most precious objects, such as consecrated vessels, reliquaries, articles of goldsmith's work, then also charters, deeds, etc.

The cathedral of Paris had its treasury over the sacristy. (Arts. Sacristie, Palais). The S. Chapelle of the palace at P Paris likewise possessed a pretty annexed edifice, that contained the treasury of charters. Also at the chapel of the castle of Vincennes (Art. Chapelle). Also frequently the treasuries of churches were constructed in the interior itself of the edifice. One still sees at the cathedral of Rheims in the side aisle of the southern transept the mezzanine treasury enclosed by a grille, that contained the beautiful objects possessed by the chapter of that church. At the cathedral of Rouen and in that of Evreux, the treasury is only a grated chapel. At Sens and Troyes the treasuries of the cathedrals are attached to the church at the south side of the choir, and are reached by stairs opening in the side aisle. In castles the treasuries of charters were placed in the keep, and those of the vessels in a tower near the great hall, that of the chapel being beside or over the sacristy. These treasuries were habitually vaulted and therefore protected from fire, being lighted only by windows elevated above the ground and carefully grated. Their doors were of iron and doubled, or at least were furnished with two fastenings. There is still seen in the mansion of Jacques Coeur at Bourges the room, that served as a treasury.





The custom of arranging in castles or mansions rooms particularly intended for the preservation of treasures, and especially of the archives, does not appear among lay lords till the reign of Philip August. Until then it was the custom among the nobles to carry everywhere with them their precious deeds and most of the precious objects that they possessed. That was a Merovingian habit widely extended among all peoples of Indo-European race. The chieftain only trusted himself alone to care for his property and his family, and during the Roman epoch armies of barbarians marched only when accompanied by heavy wagons, that carried old men, women and children, and the spoils collected in war. During the campaign of 1194 against Richard, the baggage of Philip August fell into an ambuscade placed near Freteval in Vendomois by the king of England, who thus laid hands not only on the vessels and jewels of his rival, but also on the registers of quit rents, vassalage and servitude, "in brief the complete archives of France, that the kings were accustomed to carry with them in all their bournes. The chronicles of S. Denis state, that it was a hard task to repair this loss and to restore everything to its legitimate state."<sup>1</sup> After that event the French kings deposited the registers of the State in a fixed residence. The charter room of France was placed in the Temple at first, then a part was transferred to the great tower of the Louvre, and a part to the treasury of S. Chapelle, of which we have spoken above.

Note 1.262. Chronique de S. Denis (Histoire de France by M. Henry Martin. Vol. III. p. 551.

#### TRIBUNE. Tribune. Gallery. Apse.

A principal part of sacred edifices according to the academicians de la Crusca. In fact in the primitive Christian basilicas, the tribune is the semicircle forming the apse, where was the bishop or abbot surrounded by his clergy (Arts. Choir, Transsept), in memory of the place occupied by the pretor in the antique Roman basilica. The Fathers of the Church sometimes give the name of tribunal to one of the ambos placed at the sides of the choir, notably to that on which was read the gospel to the believers assembled in the aisles.<sup>1</sup>

Note 1.p.263. Also in 1527 at the council of Lyons: - (Latin quotation).





The top of the rood loft, where was likewise read to gospel, and from which believers were instructed, thenceforth took the name of tribune. By extension the name of tribune (gallery) in the church was given to every part elevated above the floor, either on columns and arches or on corbellings.<sup>2</sup> Thus those religious edifices had their rood lofts, galleries for the organ, clock and the treasury; sometimes also private galleries reserved for some privileged believers, great personages, families of founders, etc. Men ascended to these galleries raised above the pavement by stairs opening either into the church or in adjacent buildings, when they are private, i.e., reserved for certain personages. Galleries were also a means of increasing the areas assigned to believers in little churches. We have to occupy ourselves here only with galleries included as internal and elevated annexes of churches, not as sanctuaries, ambos or rood lofts. (Arts. Jube, Choeur). Now the use of galleries dates back very far. Galbert relates how in 1127, Charles the Good was assassinated in the gallery to which he had ascended to pray with Thancmar, castellan of Bourbourg; a gallery made in church S. Donatien at Bruges. The bodies of these two personages having been transferred into the choir by the religious to be interred, the party that had committed the murder resolved to carry them away:- "The following night the provost ordered the church to be supplied with arms and sentinels to be in the gallery (solarium) of the tower, so that he could retire there with his men in case of an attack by the citizens. According to the order of the provost, armed knights on that night entered into the gallery of the church."<sup>3</sup> Those miserable men (the partisans) not being able to take possession of the lower parts of the church, had barricaded with timbers and stones the stairs leading to the gallery, so that no one could ascend there, and they could not descend, and they only sought to defend themselves from the height of the gallery and from the tower. They had established their places between the columns of the gallery, with piles of boxes and benches, from which they cast stones, lead, and all sorts of heavy articles on those that attacked. Finally, the canons of the church ascended from the choir into the gallery by ladders."<sup>4</sup> These curious passages show that the gallery in question was placed beneath the tower of the church, that it had stairs communicating with





external buildings, and that it was near the choir. It was a room in the second story opening into the church by open arches, like the upper galleries of the side aisles of our churches of the 11 th and 12 th centuries. If that room served as a gallery, i.e., as an oratory elevated above the floor of the church, it did not have the entirely exceptional form that we now attach to that part of the religious edifice.

Note 2.p.263. In Latin, solerium.

Note 3.p.263. Golbert, Vie de Charles le Bon, translated by M. Guizot.

Note 4.p.263. The same. Chap. 14.

A gallery of a very frank character and of a very early epoch (about 1130) is seen in the narthex of the abbey church of Vezelay. <sup>1</sup> We find another in the little church of Montreal, set back against the facade and looking toward the choir, whose arrangement is very remarkable. Fig. 1 presents at A the plan of that gallery, and B is the section made on a b. One ascends to that gallery by two stairs opening in the side aisles, made within the stone of the front wall. Entirely constructed of hard stone, it rests on a twin monolithic column and four great corbels composed of long projecting stones corbelled.

Note 1.p.264. Art. Porche, Fig. 4.

The arrangement of the column with corbels is extremely interesting in construction, because combined with the mullion of the doorway. <sup>2</sup> An altar table supported on a solid balustrade and on a single twin column, is placed on the axis of the gallery at C. The tails of the voussoirs D of the archivolt of the doorway and the tympanum E naturally separate downward the entrance doors P of the gallery. A rose window in excellent style opens at G below the vaults of the nave. Fig. 2 gives the perspective view of that gallery, taken from the nave. This work was conceived and erected at the same time as the facade, which dates from the end of the 12 th century, since the construction of the corbelling is intimately connected with that facade, and that the two stairs were reserved in the wall in building it. The church of Montreal is small, and it is terminated by a square sanctuary with a transverse aisle and two little chapels, also on a square plan and orientated. The gallery can easily contain 20 to 25 persons, and thus adds to its area. Perhaps it was reserved for the lord, for the church was attached to a





castle of which remain no traces. The position of the little altar makes this believed. This gallery could thus serve as a private chapel. Constructed of magnificent materials cut with remarkable purity, this church and its (so rare) gallery, among the monuments of Burgundy, is one of those presenting the greatest interest.

Note 2.p.264. Art. Poste, Figs. 63, 64.

Everyone knows the gallery of the cathedral of Paris, that in the interior rises beneath the great western rose window between the two towers, and whose arch serves as a shore at the bases of those towers. This gallery was constructed at the same time as the lower part of the facade, and consequently dates about 1210, and serves today for the front of the great organ. It consists only on an arch that spans the entire width of the centre aisle, and of a cross vault. Its width it occupies half the depth of the towers and connects the beautiful vaulted halls in the second stories of those towers by wide arches. Two other similar arches open into those halls and directly into the nave.

We shall here speak only of the halls of the second story, of porches or bell towers placed on the axes of the principal aisles, and that open into those naves and are actual galleries, because we have occasion elsewhere to mention these arrangements.<sup>1</sup>

Note 1.p.267. Arts. Clocher, Porte.

In the 14<sup>th</sup> century were erected in the interior of the cathedral of Laon, three galleries below the gables of the western facade and those of the two transepts, to shore the piers of the 6 towers, that flank these gables. These three galleries have no definite purpose, but this is an utilized means of strengthening. They consist simply of a raised arch and cross vault turned between the piers of the first bay. During the second half of the 15<sup>th</sup> century, a gallery was erected in the first bay of the nave of the cathedral of Autun.<sup>2</sup> This gallery was designed to carry an organ front, and is arranged on the original plan as shown at A, Fig. 3. It occupies a trapezoid abcd, whose angles b, c, are abutted by the arches b,f; c e. The vault with diagonal arches, ribs, liernes, etc., is complex and quite flat! This is a well conceived construction of the old piers that one claims to modify. One reaches the floor of the gallery by two old screw stairs, that originally gave access





to a sort of external loggia, which was replaced by a beautiful porch<sup>3</sup> about the end of the 12 th century. The perspective view of this gallery exhibits its construction and character. At B is one of the two flying buttresses that resist the thrust of the vault, whose head arch b c is borne on the two keystones of the oblique joints b and c. There is a combination very simple in its principle, from which can be derived an excellent method. The cusps and pendants add nothing to the stability and are not in the best style, applied to construction in stone.

Note 2.p.267. The construction of the cathedral of Autun dates in the 12 th century. Art. Cathédrale. Plg. 27).

Note 3.p.267. Art. Porche. Plgs. 12, 13.

Independently of these open galleries, built to receive singers, organs or a privileged public, there were sometimes made in abbey or parish churches little closed galleries, especially in the chapels of castles, designed for certain personages. This custom became common during the 13 th century. The abbots no longer descended to the choir, but had their gallery. The lords also had their special gallery, either in the parish church or in their own chapels.

Here (Fig. 4) is one of these little closed bays built in the front wall of the side aisle of the abbey church of Montvilliers. This church is Romanesque; but in the 15 th century, a side aisle was rebuilt, in the wall of which is arranged a bay.<sup>4</sup> At A is traced the plan of the bay with the stairs leading to it, and at B is the elevation of the side aisle. This tracery was fitted inside with curtains, so that those present at the ceremonies could look into the church without being seen.

Note 4.p.267. These details were furnished to us by M. Protel, architect at Roure.

The service of the galleries sometimes assumed great importance in the chapels of castles.<sup>1</sup> One was arranged for the lord and his family, others for the occupants of the castle and the attendants. The garrison and all the servants stood on the pavement of the ground story. It sometimes occurred that these galleries were made of wood. The great halls of castles likewise possessed this sort of galleries of joinery, painted and decorated by fabrics. There were placed musicians on feast days and banquets, ladies, or strangers which it was desired to honor





on days of hearings. This kind of gallery was erected in a corner of the hall, and was reached by external stairs.

Note 1.p.269. The royal chapel of Vincennes possesses a beautiful gallery beneath the western rose window, which consists of a pointed arch with cross vault spanning the width of the interior.

In the churches were also suspended wooden galleries to receive organs, choirs or privileged persons. At the cathedral of Rheims are still seen the remains of one of this sort of galleries attached to the north gable wall of the transept, and that dates from the 15<sup>th</sup> century. Above the doorway of the principal entrance of the cathedral of Amiens also exists a wooden gallery, whose construction dates at about 1500, and that rests on an armed truss, masked behind three wooden arches.

The church of S. Andoche of Saulieu still possesses a pretty wooden gallery of the end of the 15<sup>th</sup> century above the central doorway. Fig. 5 gives a perspective elevation of it, taken from the interior of the nave.

At A is sketched the system of construction of these galleries of carpentry and joinery. The tiebeam B is halved to allow the kingpost C to pass, that rises to the beam D and receives the two principals E. Struts C relieve the intermediate parts of the tiebeam, their feet resting on the lateral walls at I and joined to the lower end of the kingpost C, fixed by the two principals E, and<sup>2</sup> decorated facing covers the tiebeam, and the balustrade joinery fixed from B to D stiffens the entire system. The joists rest on a beam fastened behind the tiebeam. An analogous system is applied at the cathedral of Amiens, although the span is much greater.<sup>1</sup> The carpentry truss forming the front of the gallery is divided in three bays (at P). The kingposts are likewise halved into the tiebeam H. The trapezoid K L M N supports the heads of the kingposts, that receive the feet of the struts O. The junction of the principals with the tiebeam is maintained by bolted stirrups, and by two struts K N. A triple arch in joinery appears suspended, conceals the kingposts and struts, and contributes stiffness to the whole. These arches standing on corbels in the air are not then a vain ornament, but the actual decoration of the carpentry structure.

Note 1.p.270. The span of the gallery of the church S. Ando-





Andoche of Soulieu is only 18.5 ft.; that of Amiens is 45.2 ft.

Men erected galleries on the places during public festivals, to place thereon singers and actors that recited the mysteries before the multitude. During tourneys, galleries of carpentry covered by fabrics and shields of arms were built at one side of the lists and served to shelter the lords and ladies. But these temporary works are outside the domain of architecture.

#### TRIFORIUM. Triforium.

A word in use in low Latin (formed from the Greek), introduced in the vocabulary of architecture by English archaeologists, and that is applied to galleries extending internally around churches above the archivolts of the side aisles.<sup>1</sup> The triforium either occupies the entire width of the side aisle, or it is merely a narrow service gallery against the roofs of the side aisles. Most of our great churches of the North possess a triforium, that is only a tradition of the gallery (ambulatory) of the second story of the Roman basilica. When the triforium occupies the entire width of the side aisle, it is vaulted after the beginning of the 12th century, and from the origin its function is determined more by a need of stability, than by the needs of the service of the church. As long as the naves of churches were covered by visible carpentry like the Roman basilica, if the architect erected a gallery in the second story, for example as at S. Remi of Rheims,<sup>2</sup> he could scarcely think of vaulting it; he contented himself with turning a transverse arch from each pier, that received the inclined rafters supporting the shed roof covering, that shored the great walls of the nave, but which could only exert on those walls a thrust, that the weight of the upper parts could not neutralize. It was quite different, when men replaced the visible carpentry by vaults, even by tunnel vaults. Those vaults were soon weakened by the spreading of the walls under the action of their oblique pressure; it was necessary to think of maintaining those walls in their vertical planes. Then they had the idea of throwing lengthwise over the galleries of the second story a half tunnel vault or continuous flying buttress to abut the thrust of the central tunnel vault. From the end of the 11th century, the school of Auvergne arrived at this result, whose efficiency can be proved, if one visits the churches of Issoire, S. N





Nectaire, Notre Dame du Port at Clermont, S. Etienne of Nevers, and even of S. Sernin of Toulouse. The transverse arches of the primitive galleries, (see Fig. 1 of Art. Travee), were retained, and the inclined wooden rafters were replaced by this half tunnel vault on which was directly laid the covering of tiles or stone slabs.

Note 1.p.272. See Du Gange, Glossaire.

Note 2.p.272. Art. Travee, Fig. 1.

Fig 1 explains this modification of the primitive procedures. At A is again seen the bay of the gallery with its transverse arches at the piers, and its joists supporting the covering; at B the joists are replaced by a half tunnel vault abutting the continuous thrust of the central tunnel vault C. Besides, do not forget, that before deciding to throw vaults over the high naves, they began by contenting themselves with transverse arches partly bearing the carpentry and the covering.<sup>1</sup> In the provinces where men did not at first dare to suppress the carpentry to substitute for it tunnel vaults between the transverse arches of the nave, it was natural to replace likewise the ceiling of the shed roofs of the galleries by half tunnel vaults. But this new system of construction obstructed the high windows, formerly pierced beneath the carpentry of the central naves. Thus the churches of Auvergne mentioned by us have none, while only little openings light the triforium.

Note 1.p.273. Art. Travee, Fig. 2.

The tunnel vaults of the high naves were not all at first trussed concentric with the transverse arches. One sees that in the naves covered by carpentry during the 11 th century, the transverse arch supported a gable with the opening, on the slopes of which rested the joists of the roof.<sup>1</sup> Then the transverse arch was left in its place as seen at D (Fig. 1),<sup>2</sup> turning the tunnel vault at D instead of the ceiling. The half tunnel vault E of the triforium abuts the arch H of the nave. The opening of the triforium is then at I. Yet one gains nothing by leaving the transverse arches of the central nave below the tunnel vault, which was only a tradition of a preceding arrangement of edifices covered by visible carpentry; then these transverse arches were raised so as to make their extrados concentric with the tunnel vault as seen at M.<sup>3</sup>

Note 1.p.274. Art. Travee, Fig. 2.





Note 2.p.274. Section of the nave of church Notre Dame du Port at Clermont.

Note 3.p.274. Arrangement of the nave of the church of Issoire.

Fig. 2 presents the perspective view of the triforium of the nave of the church of Issoire. In this nave, that dates from the last years of the 11th century, the bays are double, i.e., the engaged columns A and the transverse arches B exist only between alternate piers; the pier C only being intended to receive the transverse arches and the imposts of the vaults of the side aisles. But one sees at D a transverse arch of the gallery as one exists at the piers A. At E is the springing of the continuous tunnel vault of the high nave, and through the arcade of the triforium at G is perceived the half tunnel vault, which abuts that central vault. The same arrangement is at Notre Dame du Port and at S. Etienne of Nevers. In these edifices the triforium has exactly the character suited to its purpose. The wall of the nave is perforated to profit by that gallery necessary to the stability of the monument, and that gives a little light to the high vaults of the church. If this method was suitable for naves of moderate dimensions, -- the low windows of the side aisles then admitting sufficient light because of the small width of the interior, -- it was inadmissible in the construction of a great church, such as S. Sernin of Toulouse, provided with double side aisles; for in the last case, the central nave would have been left in obscurity. Not being able to open windows below the springings of the tunnel vaults, it was at least necessary for those of the gallery to be sufficiently high and wide to light that central nave through the arcades of the triforium; thus in this last edifice, the triforium takes an importance other than that at Issoire and Notre Dame du Port. This will be judged of by the elevation given here (Fig. 3). At A is sketched the plan of this gallery with an angle pier B; for the triforium of the church S. Sernin returns at the ends of the transverse aisle. Wide windows C light both the gallery and the middle of the interior. The half tunnel vault with transverse arches, that springs above these windows, abuts the central tunnel vault, reinforced by transverse arches. This is the system adopted in the churches of Auvergne, but is more developed. <sup>1</sup>

Note 1.p.277. In Art. Proportion, Fig. 2, see the transverse





section of the church S. Sernin of Toulouse. Also see Archives des monuments historiques, published under the auspices of the minister of Fine Arts.

Yet the development of the triforium in the church S. Sernin of Toulouse did not permit opening direct windows in the nave. Under the climate of the South, this means could suffice; but under the foggy sky of the North, the light transmitted by these second windows could scarcely light the high naves; it was necessary for the windows to open directly into these naves above the triforium. Thus in the provinces situated north of the Loire, men did not cease to make direct openings under the carpentry, and when they renounced the carpentry, beneath the vaults that must replace it. This was one of the causes that prevented the architects of the North from adopting the tunnel vault (Art. Voute), and which compelled them to seek combinations of the cross vault. The tympanums beneath the side arches of the vaults in fact permitted making openings in the heights of the vaults themselves. Yet they did not renounce the vaulted triforium, which was regarded as a means suitable to maintain the walls of the high naves in a vertical plane, and to abut the vaults surmounting them. Several churches of the epoch of transition show us various attempts made in this sense by the masters of the French provinces of the North. We shall cite in this place the abbey church of S. Germer, whose construction dates back in the last half of the 12th century.<sup>2</sup> The bays of the choir of this church possess above the side aisle a triforium vaulted in the Roman way without diagonal arches. This gallery opens into the church by an arcade, and the roof surmounting it covers the flying buttresses intended to resist the thrust of the high vaults.

Note 2.p.277. The abbey church of S. Germer in construction is behind the abbey church of S. Denis and the cathedrals of Noyon, Senlis and Paris; it belongs to a less advanced school, that adheres to the Romanesque system in many points; because of that we place it here in the first line, if not by the date (for it was erected in 1160), but by the style.

The section (Fig. 4) made across that gallery explains the system of construction adopted. The half gables A B that rise on the flying buttresses also serve to bear the covering, that consists of joists with half trusses in the circular parts.





Openings C are pierced beneath the shed roof and open into the church below a narrow service passage arranged at D, to facilitate the maintenance of the glass of the upper windows F.

Fig. 5 gives the internal elevation of this triforium with the rectangular windows E of the roof and the service passage G.<sup>2</sup> At H is sketched one of the parallel bays of the choir, and at L is one of the bays of the semicircle, developed on a rectilinear plan. One will observe that the opening with twin columns rests on a parapet wall (see the section in Fig. 4). This parapet wall prevents persons from occupying the gallery from looking down into the church, unless they lie flat on the sill wall.

Note 3.p.277. In Archives des monuments historiques, see *Topographie de S. Germer*, by M. Boeswilwald.

The architects of the cathedrals of Noyon, Senlis, Soissons, Paris, and the churches of Mantes, the choir of the abbey church of S. Remi of Rheims, and that of the abbey of EU, etc., renounce this sill wall, and cause the bases of the columns of the openings to rest directly on the floor of the gallery. Balustrades of wood or of iron placed between these columns allow those present in the galleries to see the pavement of the church. The half Romanesque and half Gothic system adopted at S. Germer retains the high windows M (Fig. 5) of the primitive basilica, thanks to the application of the system of cross vaults with pointed arches, then entirely novel.<sup>1</sup> Yet those upper windows are very high above the pavement of the church, and light little but the vaults; the windows pierced in the wall of the triforium (see section at P) were too far from the tracery to light the interior at the pavement; the more so that this triforium is low and deep, and the sill wall forms a screen. The architect of the choir of Notre Dame of Paris resolutely adopted a different method; as we have just stated, he suppressed the sill wall and raised the vault of the triforium. The master that a little later, about 1195, erected the nave of the same church, also improved the arrangements made by his predecessor, from the point of view of introducing the light into the central part of the interior. He constructed the vaults of the triforium as transversely rampant, so as to completely show the windows of this gallery to the public on the floor of the church. In Art. Cathedrale (Figs. 2, 3, 4), we took into account that arrangement so clearly, that it is unnecessary





to return to it here. At Notre Dame of Paris, rose windows replace the rectangular windows, that in the church of S. German are opened in the wall against which leans the shed roof. The internal service passage that surmounts these windows at S. Germer, do not exist at Paris, but do exist at the cathedral of Noyon;<sup>2</sup> and there is in the semicircular transept of the cathedral of Soissons as a second triforium, or narrow gallery with arched opening, that replaces the rose and rectangular windows.<sup>3</sup>

Note 1.p.280. Arts. Construction, Oeuvre, Trouee, Voute.

Note 2.p.280. Art. Trouee, Fig. 5.

Note 3.p.280. In Art. Architecture religieuse, see the perspective view of the beautiful vaulted triforium of the south transept of the cathedral of Soissons. Also in Art. Construction, Figs. 41, 43, see the arrangement of the triforium of the choir of Notre Dame of Reims-sur-Meuse.

These wide vaulted triforiums were expensive in construction, and could only be appropriate for very great edifices. To find windows in the tympanums of the high vaults, they required an extra height of the walls to receive the shed roofs, that covered the galleries of the second story. Their utility only made itself felt during great solemnities, and only the two or three first rows of believers in the galleries could see what occurred in the church, even if the sill walls of stone were suppressed, as at Notre Dame of Paris, at Mantua and at S. Remi of Rheims. For churches built with more economy, and in which there was no occasion to receive a great multitude of the faithful, the vaulted triforium could not form a part of the programme. Thus the churches that date from the same epoch as those mentioned above, and that belonged to the same school of architects, were not provided with them. Yet we shall find in Ile-de-France a continued tendency to retain this system. It is no longer the vaulted gallery occupying the entire width of the side aisle, but no more than a triforium leaving a narrow gallery, a service passage within the abutting roof of the side aisles, as in the cathedrals of Rheims, Amiens, Bourges and Chartres. This intermediate system is adopted in the abbey church of S. Leu d'Esserent.<sup>1</sup> Here (Fig. 6) is the section of the triforium of the nave of that church. The wall receiving the roof A of the side aisle does not rise sufficiently to prevent the opening of little windows B. Without a vault, a relieving arch C recei-





receives the upper part of the wall, and the passage rests entirely on the vault of the side aisle. In the interior that arrangement presents the appearance reproduced in perspective in Fig. 7. As if to recall the vault of the grand triforium, the architect has turned the arch D, that is no more than a sham, since the true relieving arch is much lower and simply segmental (see the section). The triforium thus contracted has no need of being covered by a shed roof, but simply by a slab G (see the section), the high windows can be opened directly over the arch D (see Fig. 7), and even if the constructor had not adhered to the construction of that arch, he could have placed the sill of the window much lower. It is well understood, that this system imperatively requires the construction of flying buttresses to maintain the upper vaults, for they no longer had to renounce the half gables within the shed roofs of the vaulted gallery, for fulfilling that function, as had been practised at S. Germer.

Note 1.p.281. This church dates from the first years of the 13<sup>th</sup> century.

Another monument, contemporaneous with the church of S. Léon d'Esserent, gives both the vaulted gallery and the narrow triforium lighted by windows; this is the little church of Moret. The parallel parts of the choir of that church possessed a gallery in the second story or vaulted triforium over the aisle; but the semicircular apse without side aisle has above a row of low windows a triforium, whose original composition shows us a series of lunettes or rose windows without tracery, between which is arranged a passage. The perspective view (Fig. 7)bis) explains this irregular construction. At A is the triforium sketched according to the method of Ile-de-France, i.e., vaulted. A stairs placed behind the surface B ascends to the triforium of the apse, which is no more than a passage traversing the piers and opening by circular windows on the exterior and interior of the church. One notes that those windows (see plan at P) are not pierced normal to the curve of the apse, but are askew, so as to be seen from the entrance of the choir. Penetrating a cylinder, those eyes are never filled by tracery; their glass is set in the external circle, and is only maintained by iron bars. The details of this part of the church of Moret are in the best style of the first years of





the 13<sup>th</sup> century. It should not be forgotten, that at the church of Mantes exists a wide vaulted gallery like that of the cathedral of Paris, lighted by circular windows, and that this gallery over the side aisle of the apse presents an arrangement, that although conceived according to very monumental ideas, appears to have furnished the scheme for the composition of that of Moret. The apsidal triforium of Mantes dates from the last years of the 12<sup>th</sup> century. Either the architect desired to avoid the difficulties resulting from the combination of vaults on an annular plan, or he may have feared the thrust of these vaults on the exterior of the cylinder (a thrust at Notre Dame of Paris neutralized by a series of quite complicated flying buttresses erected on the second side aisle), because he had only one side aisle, and the construction was evidently executed with parsimony; the fact is that this architect vaulted the apsidal gallery of the church of Mantes by means of a series of convergent tunnel vaults. The section (Fig. 7) explains this system of construction; the columns A rest on the lower transverse arch; they represent lintels of hard stone on which rest the tunnel vaults B. But since these columns are set normal to the semicircle in plan, the bays are wider at the exterior C; it results from this that these tunnel vaults are either camp-shaped or present skew curvilinear surfaces. The architect of Notre Dame of Mantes appears to have decided on the last arrangement after some experiments; i.e., he desired to maintain the crowns of the pointed tunnel vault at a level or nearly so. Then the trace a c of the tunnel vault is not concentric with the trace b d (see at M). The openings n are circular. It is clear that the architect of the church of Moret only had to express at a smaller scale what had been done at Mantes some years before him.

These examples of these varied deductions show how those masters continually sought to perfect what they saw done around them. Without abandoning the principle adopted, and without flatly imitating what seemed to present the most satisfactory results, on the contrary they claimed to develop that principle, to deduce from it all its consequences; and before all, they knew that a system of construction must be modified according to the dimensions of the edifices.

But in other provinces they proceeded differently; the trif-







triforium after the 13 th century was only an opening made in the wall receiving the roof of the side aisle; an opening allowing the eye to penetrate from the interior to beneath the carpentry. Yet at the origin, these openings were rather windows pierced at certain distances in the tympanums of the blind arcade, than of a gallery (Art. Travee, Fig. 2). Only about the middle of the 12 th century the blind arcade with windows opening under the roofs of the side aisles was transformed into a real window. The choir of the cathedral of Langres, that dates from that epoch, furnishes us with a beautiful example of those arcades opening in the wall receiving the carpentry of the side aisle. Fig. 3 gives the elevation and plan of the triforium of the cathedral of Langres, assuming the bay developed on a plane, that apse being circular. At A is traced the plan. The vault B is a pointed spherical vault penetrated by the high windows C. Little twin columns <sup>1</sup> support the double arch forming the gallery between the piers of the semicircle. This method could be adopted in an apse, where the bays are narrow. It would have been dangerous to rest wide and thick tympanums on a series of little columns. Those in the nave of the same church and triforium are only a blind arcade pierced by a middle opening in each bay. The same system was adopted at the cathedral of Autun, that is a little earlier than that of Langres. Yet the architects adhered to occupying the space between the archivaults of the side aisles of the high windows openings; blind arcades only present. flat decoration without utility. The master to whom is due the cathedral of Sens, whose construction presents such interesting arrangements, had the idea about the end of the 12 th century, of establishing a triforium there according to a new principle. So as to well support the upper parts, originally composed of windows with a high sill and intermediate piers, he similarly divided the gallery into two bays with an intermediate pier resting on the crown of the archivolt of the side aisle. Then in each of the bays, he established twin arches resting on a little column and two jambs. Fig. 9 gives at A the plan and at B the elevation of the triforium of the nave of the cathedral of Sens. At C is the column that bears the transverse arch intersecting the high vault. Windows rebuilt after the fire at the end of the 13 th century have replaced the old openings D, which were doubled like the principal





arch of the triforium. That construction dates from about 1130, and shows us a triforium simply pierced in the wall requiring the roof of the side aisle, as at the apse of the cathedral of Langres, without<sup>a</sup> separating partition between that roof and the opening. An analogous arrangement, but with very different architectural forms is found in another province. At the cathedral of Evreux in the first bay of the nave, partly concealed by the organ front, is a remnant of the triforium of the 12 th century, which is simply pierced in the wall receiving the roof of the old side aisle, now occupied by a tower, and is composed of an arcade with tympanums resting on small isolated piers. We give (Fig. 10) the elevation and horizontal plan. This triforium, nearly contemporaneous with that of Sens, is much less extensive from the point of view of construction; for these arches intersect and form a very mediocre relieving arch, and these tympanum-lintels might break very easily, or break off the projections of the capitals at the least movement of the structure. Yet this example again emphasizes the varied resources by which those architects of the 12 th century knew how to profit. This is an entirely Norman arrangement, and that is found again in England in the monuments of this epoch.

The triforium opening directly beneath the roof of the side aisle, presented inconveniences easily appreciated. It admitted cold and dampness into the church, for the roofing was of tiles or slates, and however well made, they always allowed the external air to pass. The view of the carpentry through these openings was not pleasing. It was difficult to maintain clearness under these roofs, and in high winds dust was scattered in the church. Hence men did not delay to isolate the triforium from the roof, i.e., to build between it and the opening a solid partition, thus forming a closing wall. It had been attempted indeed at S. Leu d'Esserent, as we have seen, but there is a mean between this last system and that of the vaulted triforium.

The nave of the cathedral of Amiens appears to be one of the first religious structures in which the architect sought frankly to separate the triforium from the shed roof by means of a fixed partition. Here (Fig. 11) at A is the plan of half a bay of that triforium.<sup>1</sup> At B is the sketch of the pier at the level of the gallery and at the level of the ground story; at C





the buttress that supports the column receiving the head of the flying buttress,<sup>2</sup> and at D the partition of masonry with a relieving arch. At E is given the elevation of this triforium next the nave. At G is seen the relieving arch of the partition, As at Sens, the opening is divided into two bays, the little pier P supporting the central mullion of the window and resting on the crown of the archivolt of the side aisle.<sup>3</sup> At H is traced at a larger scale the horizontal projection of the little pier B with the abacuses of the capitals, and that of one of the little columns; and at I is the section of the moulding of the arch I'. One will note that this gallery being placed at a great height, and the width of the nave not being able to give much recession, the horizontal mouldings, such as the bases and abacuses, are very developed in height and project little, so as not to be concealed by perspective projections.<sup>4</sup> Often the capitals of the little columns of those triforiums of the middle of the 13 th century have very low and hollowed courses, so as to develop their projections to the eyes of persons standing on the floor. A very remarkable example of this system, a adopted because of the perspective effect, is found in the cathedral of Châlons-sur-Marne. At Notre Dame of Amiens it is seen that the architect, preoccupied by the perspective diminution of his arrangement of the gallery, has exaggerated the proportions in height with reference to the width. By such attention to the conception of the different parts of an edifice, the masters are recognized. In drawing the elevation, they evidently take account of the deformations produced by the height and relative distance of place; they obtained the desired effect without being compelled, as one frequently sees today, to experiment and to modify in place entire portions of edifices, to obtain after these costly trials only indecisive proportions or incomplete effects.

Note 1.p.290. Art. Trouee, Fig. 10.

Note 2.p.290. Art. Cathedrale, Fig. 20; see the section.

Note 3.p.290. Art. Trouee, Fig. 10.

Note 4.p.290. Art. Profil, Fig. 26.

The section of the triforium of the nave of the cathedral of Amiens (Fig. 12) made on a b shows the skill of the constructor. In that section, one sees at A and B the two concentric pointed arches that form the archivolt of the gallery. At C is the int-





internal reinforcement at the great piers, and at D is a connecting lintel. The archivolt B starts on the capital of the little internal reinforcement of the little pier P of the plan, and penetrates the reinforcement C. At E is the ceiling of the triforium forming a passage above the roof F of the side aisle. At G is the isolated column that receives the relieving arch marked G on the sketch (fig. 11); at I is the partition closing the attic, and at L a relieving arch bearing that partition and allowing the vault of the side aisle to pass under its intrados. The great upper windows open in M directly above the triforium.<sup>2</sup> Yet the walls receiving the roof of the side aisle appear naked, when seen behind the opening of the triforium; men soon decided that they must be perforated, and in the same church (Notre Dame of Amiens), the architect that erected the high part of the choir established hip roofs over the side aisle, so as to be able to open windows in the enclosing walls of the triforium. Thus these triforiums soon participated in the upper windows.<sup>3</sup> About the middle of the 13th century this system was adopted in a great number of churches of the royal domain, notably at the cathedral of Troyes and at the abbey of S. Denis, in great part rebuilt under the reign of Louis IX. The triforium of the nave and choir of the last church is very remarkable in composition. We give (Fig. 13) the plan A and the elevation B of half a bay of this triforium. At C is sketched the rear window C' of the plan, which receives the glass; so that one perceives the glass of this opening C through the front arches. Here the triforium is more intimately connected with the great upper windows than at Amiens, by means of the little columns D of the tracery. But the tympanums F of the two arches are still solid, while a little later those tympanums are themselves perforated as at Notre Dame of Paris, beneath the rose windows of the transepts (1260), in the choir of the cathedrals of Beauvais and of Troyes (1250), in the choir of the cathedral of Seez (1270), in the abbey church of S. Ouen of Rouen (1300). Then the triforium is only the continuation of the upper window, and is separated from that only by a slab forming the ceiling of the glazed triforium of the floor of the passage above that. Fig. 14 explains this arrangement adopted in the abbey church of S. Denis. At A is the floor of the triforium; at B the floor of the passage. At S. Denis the triforium everywhere has the





same width and is not narrowed by the reinforcements at the piers, as at the cathedral of Amiens. The buttress C bears the column D which receives the head of the flying buttress.<sup>1</sup> The side aisle was covered by hip roofs with a gutter E, so as to permit the opening of windows in the partition G.<sup>2</sup>

Note 1.p.292. Art. Gothedrale, Fig. 26; see section of nave.

Note 2.p.292. Arts. Travee, Fig. 10; Fenetre, Fig. 20.

Note 3.p.292. Arts. Travee, Fig. 11; Architecture religieuse, Fig. 36; Fenetre, Fig. 24.

Note 1.p.296. Art. Architecture religieuse, Fig. 36.

Note 2.p.296. See Art. Troit, Fig. 4, to take account of the portion of this triforium at the piers.

Perhaps the most complete and most developed example of the triforium absolutely connected with the upper window is found in the choir of the cathedral at Seez, whose construction dates from about 1270.<sup>3</sup> This monument was conceived in a very wise way, but was badly founded on bad soil, and has much analogy to the choir of the church S. Ouen at Rouen. The defects in construction, that have compromised the durability, belong to insufficient execution and probably a lack of resources. From the point of view of theory, the choir of the cathedral of Seez even would excel in value that of the abbey church of S. Ouen, had it been founded on a good soil, and if the materials had been properly selected, and with a strength proportioned to the loads that they have to bear.<sup>4</sup>

Note 3.p.296. Art. Travee, Fig. 11.

Note 4.p.296. The foundations of the cathedral of Seez are merely masonry belonging to a much older monument, on which the structure was placed badly, and thus poorly built foundations are not placed on a resistant soil. Evidently there was a necessity for economy.

Fig. 15 gives the triforium of one of the parallel bays of the choir of the cathedral of Seez. The archivolt A of the side aisle is surmounted by a gable, behind the rake of which extend the little columns, that form the window of the triforium and the high window. The arrangement of that upper part then commences directly above the archivolt (Art. Travee, Fig. 11); and from the level B the sections of the arcade of the triforium and the tracery of the window. A single slab C forms the sill of the window, covers the passage of the triforium and serves





as an external walk above that passage. As at S. Denis and as in the choir of the cathedral of Amiens, the external glazed window D is no similar to the inner window, which is very well calculated; for if the forms of the open tracery are alike outside and inside, there result in perspective superpositions of lines with a bad effect. On the contrary, these traceries being different, the eye naturally separates them, and the intersections of the curves produce varied and rich combinations. At s Seez, as at S. Ouen of Rouen, there is no longer a solid sill wall, but a perforated balustrade forming the sill of the triforium, so that for persons on the lower floor, the glass of the outer window D is seen through that balustrade. The intention of opening more and more the bays over the side aisles, and of making them a sort of translucent tapestry without interruption, must evidently date from the second half of the 13<sup>th</sup> century, and appears about the end of the 14<sup>th</sup> century in Ile-de France and the adjacent provinces with rare exceptions. Like the high windows themselves, the triforium then occupies the entire space between the piers. Three religious monuments of that epoch (end of the 13<sup>th</sup> century), very probably due to the same architect, form an exception to this rule; these are the cathedrals of Clermont and Limoges and that of Narbonne, whose choirs were only completed before the 14<sup>th</sup> century. In these three churches the high windows do not entirely occupy all the free space between the piers supporting the arches of the vaults; they are narrower, and the opening of the triforium only occupies the width of the windows. These passages of the triforium are not opened externally, but have a solid closing wall, although the side aisles are covered by terraces, that in our opinion was only temporary. Further, those passages extend around the piers instead of passing through, as in the North.<sup>1</sup> It is necessary for this system to have the freedom of the mode of construction adopted in our northern provinces. The arcades of the triforium are detached from the piers and leave a pier at right and left, do not produce a good effect or explain themselves clearly. And in fact no requirement of construction is a motive for this sort of mullions loading the piers without reason.

Note 1.p.298. Art. Architecture religieuse, Pl. 38.

While the triforium developed thus by forming one with the





upper window in the North, the architects proceeded otherwise in Burgundy in the 13<sup>th</sup> century. They retained the solid closing wall to receive the shed roof of the side aisle, and instead of reserving above the triforium an external passage, they placed it inside. The upper window of the bay thus found itself raised vertically above this closing wall and no vertically over the internal opening, as in the preceding examples.<sup>2</sup>

Note 2.p.298. Art. construction, Figs. 78, 79 bis, 88.

Here (Fig. 16) is an example of that construction taken in the pretty church of S. Martin of Clamecy. One sees how the triforium assumes importance in those Burgundian monuments. It is an actual portico raised above the archivolts of the side aisles. This system cannot lead to connect the triforium with the upper window, being placed behind it; thus we see it adopted in Burgundy and a part of Nivernais only when in those provinces the local traditions are abandoned about the end of the 14<sup>th</sup> century, to resort to the architectural style of the royal domain. The arrangement of the Burgundian triforium-portico must necessarily lead the architects to decorate in a particular manner those arcades, that assume to much importance in the naves. The little columns no longer rest here on a sill wall as at Amiens, or on a balustrade, but directly on the floor of the triforium, marked by a projecting band; a disposition that also contributed to give grandeur to this arrangement. At Semur-en-Auxois, the arcades of the triforium of the church of Notre Dame are decorated by projecting heads very skilfully sculptured. In the nave of the cathedral of Nevers, little cariatids support the little columns, and figures of angles fill the spandrels (Fig. 17). These porticos are built of large materials, and in their height the piers are often composed of grouped columns.<sup>1</sup> Generally in Burgundian churches the upper windows do not have the relative importance (because of the size of the triforium), that they assume in the religious monuments of the royal domain. Fig. 16 is the proof of this. Sometimes even the triforium is confused with the upper window. The abbey church of S. Seine furnishes us with an example of that singular arrangement, dating from the beginning of the 13<sup>th</sup> century (Fig. 18). Here is the side arch of the high vault, that circumscribes the arcade of the triforium, that is no longer more than a decoration. This last system has frequently





been adopted in the Norman churches of the 12<sup>th</sup> and 13<sup>th</sup> centuries in France as in England. But the triforium in the Norman churches merits particular study. During the first period, i.e., in the 11<sup>th</sup> century, it consists of a story raised above the side aisle and covered by visible carpentry, and an upper passage at the level of the high windows. One cannot doubt today (since the work undertaken by M. Ruprich Robert in the two abbey churches of Caen, the abbey-aux-Dames and the abbey-aux-Hommes), that the naves of these churches were originally covered by visible carpentry.<sup>1</sup> Now there always exists in religious monuments of great dimensions in Normandy, a circulation passage above the triforium and beneath the upper carpentry. Here is a section of the primitive nave of the abbey-aux-Hommes (Fig. 19),<sup>1</sup> which clearly explains what we have just stated. At A is the triforium with its carpentry; at B is the walk at the level of the upper windows and under the great carpentry C. It is easy to take into account the use of this passage. The visible carpentry was composed of timbers forming projections with spaces between; they were decorated by paintings. This sort of work required frequent care, were this only a dusting, for spiders would not delay to spin their webs in the spaces left between the rafters or joists. These timbers required to be visited to prevent the dry rot caused by leaks. The walk B then facilitated this constant inspection. Further, it allowed the visiting and repairing of the glass of the upper windows, and gave passage to the roofers to repair the roofing. At E is traced a bay, or rather an internal half bay, for in the nave of S. Etienne of Caen the bays are double according to the Norman method (hexapartite).<sup>1</sup> The dotted line a b c d indicates the longitudinal section of the passage B. In the 12<sup>th</sup> century in nearly all Norman-French naves, visible carpentry was replaced by vaults. Then to abut these vaults, in the triforium A was constructed the continuous half tunnel vault D, with transverse arches f at the old pilasters f'. This half tunnel vault did not require the destruction of the passage B, no more than the upper vault; on the contrary, this passage was opened more widely next the nave and was decorated by little columns. (Fig. 20). The windows a as well as the passages were retained while raising their sills by a course, so as to find the new slope of the roof. The floor of the passage at the level b in





the Romanesque arrangement was lowered to d, to give more slender proportions to the upper gallery. The architect probably dared not open new arcades at g, as he had done at the middle pier of the bay, fearing to weaken the principal piers, and l also because the perspective of the diagonal arches partly concealed it. Thus the reason of utility that had produced the passages beneath the upper carpentry of the primitive Norman churches, when those churches were vaulted became a motive of the decoration, that persisted in the monuments of that province until the end of the 13<sup>th</sup> century.

Note 1.p.300. As in the church of Semur-en-Auxois, in the c church Notre Dame of Dijon (Art. Construction, Fig. 80), in the cathedral church of Auxerre (Art. construction, Fig. 88).

Note 1.p.301. See the Notice by M. Ruprich Robert, *Eglise de la S. Trinite et Eglise de S. Etienne et Coen.* 1864.

Note 1.p.302. After M. Robert.

Note 1.p.303. Art. Trouee, Fig. 2.

The chevet of the cathedral of Lincoln (England) furnishes us with one of the most remarkable examples of the persistence of that tradition (Fig. 21). The triforium there is still covered by visible carpentry like that of the Norman Romanesque churches, and the upper passage is combened with the window opened under the side arches. This passage no longer has any real utility, since if it did not exist, the glass could be repaired from the outside by passing along the slab forming the roof of the triforium. The internal open arcade of the passage is connected with the glazed window by means of lintels forming the course of the abacuses of the capitals. In this method is a desire to produce an effect by the play of these two traceries, the internal one of them being only a decoration. One will note in this example how the arches of the triforium are charged with mouldings and ornaments, and how this richness contrasts with the naked appearance of the visible carpentry. It is evident in this Norman architecture of the 13<sup>th</sup> century, that the Romanesque tradition retains its empire and often becomes the occasion of forms and methods no longer justified because of the changes introduced in this mode of construction. An arrangement was adopted in the choir of the cathedral of Ely, almost exactly reproducing again that of the upper passages of Norman Romanesque churches. On the contrary in our French arch-





architecture, the lay school of the 12 th century lays aside all Romanesque traditions, and is only inspired by the necessities imposed by the new method of construction: it always proceeds in a logical and clear manner, only using the necessary materials, and can always give a reason for what it does. It would be desired that one could say as much for our modern schools of architecture.

but we must limit ourselves, as the documents abound, and we can indicate here only the principal ones, those presenting a quite particular character. We hope that these examples suffice to emphasize the variety, that our masters of the middle ages knew how to bring into their conceptions, without ever abandoning an accepted principle.

We shall only speak incidentally of the triforium, whose form is unusual. The little church of Champeaux possesses a triforium opening directly beneath the roof of the side aisle by rose windows now closed, but very probably originally filled by tracery in the style of that replacing the rose windows pierced above the triforium of the cathedral of Paris. In some churches the triforium consists only of a single or double opening likewise beneath the roof. The cathedral of Beziers, in the parts of the nave rebuilt in the 14 th century, shows us a triforium so composed (Fig. 22). This opening beneath the roof of the side aisle consists of two square openings in the lines of the tracery of the upper window. Sometimes, but very rarely, in good French architecture, the triforium is simulated and then is merely a blind arcade, a mere decoration occupying the height of the roof of the side aisle. The arrangements adopted at Sens, in the cathedrals of Troyes, Beauvais and Seez, in the abbey church of S. Ouen of Rouen, persist during the 14 th and 15 th centuries. The details of the triforium become more slender, the mouldings are leaner, but no new method appears. The arcades are modified according to the taste of the moment, but they continue to be connected with the upper window. Yet at the end of the 15 th century, it sometimes occurs that the triforium assumes a special arrangement, charged with details, cusps, ogee curves and sculptures, leaving a solid interval between it and the window. In the 16 th century, men are contented to substitute, for example as at S. Eustache of Paris, forms approaching Roman architecture for the Gothic forms. These tenden-

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tendencies are more or less happy, but do not constitute an invention or improvement; these are questions of detail on which it seems useless to enlarge.

### TRILOBE. Trefoil.

Ornament, opening, open rosette, with three lobes. 7rt. Trefle).

### TRINITE. Trinity.

The middle ages attempted to represent materially the mystery of the Holy Trinity. It is necessary to have recourse to the school of Alexandria, if one wishes to know the different steps by which men must have passed from the idea of the Trinity before arriving at the condition of a dogma. it is well understood, that we do not have to occupy ourselves with the exposition of a dogma, but to render an account of the visible form given to the conception of the Trinity in our monuments of the middle ages. "From the 4<sup>th</sup> century," writes M. Didron, <sup>1</sup> "with S. Paulin, bishop of Nola, who was born in 353 and died in 431, appeared the groups of the Trinity. In the apse of the basilica of S. Felix built at Nola by Paulin himself, is seen the Trinity executed in mosaic."

Note 1.p.307. Iconog. chret. by M. Didron. Paris. 1843.

S. Paulin explains in the verses that he made on that occasion, that Christ was represented in the form of a lamb, the Holy Spirit in that of a dove, and that "the voice of the Father resounded in the sky." The same bishop in the basilica erected at Fondi under the name of S. Felix, caused the Son to be represented in the form of a lamb with the cross, the Holy Spirit as a dove, and the Father in the form of a hand (probably) that crossed the Son. (Latin verse).

As M. Didron very well observes; <sup>2</sup> "anthropomorphism, that had frightened the first Christians and served to recall paganism, did not find the same opposition in the middle ages proper. Once arrived at the 9<sup>th</sup> century nothing was to be feared from pagan ideas. The Eternal Father, whose hand they had only dared to show, or at most the bust, is shown on foot. Still he does not assume a special figure; but he borrows that of his Son, and hence it becomes very difficult to distinguish one from the other. The Son continued to appear as he had been seen on earth. The dove also sometimes left its covering of a bird, to take t





the human form. As the dogma distinctly declared that the three personages were not only similar but equal to each other, the artists extended to the representations similarity and sometimes equality of the divine hypostases. "Indeed, a good number of painters of manuscripts of the 11<sup>th</sup> and 12<sup>th</sup> centuries<sup>1</sup> represent the three divine persons in the form of three men of the same age and appearance. On the portal of the collegiate church of Ma tes, in the arch of the western portal, the Trinity is represented by a cross supporting two angels (the Son), by the Father in the form of a young man, and the Holy Spirit as a dove. But artists pretend to identify the three divine persons, so as to make understood by believers both their individuality and their union in a single power. There exists beneath the western unfinished porch of S. Urbain of Troyes a relief in wood dating from the last years of the 13<sup>th</sup> century, that represents the Trinity (Fig. 1). The Father is in the middle, or crowned with the triple tiara like a pope; he blesses with the right hand, and holds the earth with the left. On his right is the Son crowned with thorns and bearing the cross; at the left is the Holy Spirit in the form of a beardless young man, holding a dove. These three personages together have only four legs, so adroitly draped as to cause the belief that each has two. Little kneeling figures of a man and a woman (the givers) are sculptured at the two ends of the group. The impossibility of separating the three divine persons is thus materially indicated by the arrangement. Sometimes the Trinity is indicated in the form of a man having a head with three faces, one in front and two in profile with only two eyes; or indeed it is a geometrical figure arranged thus (Fig. 2). This mystic triangle was still visible on the facade of a house of Bordeaux a few years since. Stained glass and vignettes of manuscripts represent it very frequently during the 15<sup>th</sup> and 16<sup>th</sup> centuries. At the same epoch in many portals, the Trinity appears thus:— the Father is seated and crowned with the tiara, holding Christ on the cross before him. From the mouth of the Father the dove descends on the crucifix. These different representations have an interest; they indicate the advance of art as a visible expression of theological ideas according to the times. During the first centuries men evidently feared a too material expression of a mystery, that should remain impenetrable. The Son is a lamb,





the Spirit as a dove, and the Father as a voice or a hand projecting from a cloud. Later the artist is reassured, and he gives individuality to the three divine persons. They are separate and distinct, but similar and seated on a common throne. Then it is sought to make understood by a material artifice the unity of the three persons. In the 15 th century it is a sort of geometrical problem placed before the multitude, whose solution is left as an enigma; or again it is the sport of the artist, like the head with three faces. In the 16 th century was adopted a little known earlier form, that of the absolute distinction of the three persons, because of the parts attributed to them by Christian ideas. The Father is the unchangeable personage; the Son is the redeemer; and the Spirit is the emissary emanating from the Father; love, according to S. Augustine and S. Thomas of Aquinas. "Jesus, having been baptized, left the water at once, and then the heavens were opened to him, and he saw the Spirit of God descending in the form of a dove and coming to him; then a voice from heaven said; this is my beloved Son, with whom I am pleased." <sup>1</sup> It is then very important to make these distinctions in the characters given to the Trinity represented on the old monuments.

Note 2.p.307. *Iconog. chret.* by M. Didron, Paris. 1843.

Note 1.p.308. Among others, the beautiful manuscript of Herode of Londsberg, *Hortus deliciarum*. Library of Strasburg.

Note 1.p.310. Matthew. III. 16, 17.

The middle ages also admitted a trinity of evil. Likewise the theologians had claimed to find the reflection of the Holy Trinity in the human soul:-- will, love and intelligence, combined in one substance, they supposed evil to have corresponding faculties. Sculptures, paintings on glass and manuscripts indeed represented the satanic trinity (Fig. 3). <sup>2</sup> This miniature of the 13 th century shows the sinner subject to the laws of the trinity of evil, armed with the sword and crowned. Satan is often represented thus in the reliefs of the last judgment. Besides his three faces that correspond in the evil to the three hypostases of God, his body is sometimes covered by other human faces, as if the power of evil is more extended by its faculties than that of good.

Note 2.p.310. Old manuscript, property of S. Germain. Psalm 37. Library Imperiale.





## TROMPE. Trumpet.

Masonry of voussoirs in the form of a shell, that serves to support a corbelling, either a straight surface projecting at a cut-off angle, or a straight surface at a reentrant angle. The constructors of the middle ages made great use of trumpets to support octagonal stone spires on square towers, watch turrets on walls and corbelled turrets. They employed trumpets instead of pendentives to establish domes on transverse arches resting on four piers.

Trumpets are jointed, either by means of a series of concentric arches, or in form of a cone. Fig. 1 gives a trumpet composed of concentric arches splayed at  $45^\circ$ , so as to join the sides of the square. At A is traced the horizontal projection of one of those trumpets, at B its elevation and at C its section. This sort of trumpet is the oldest, and is found in the monuments of the 11th century; they are easily built, each arch being independent. They are often seen at the base of spires of the 11th and 12th centuries to pass from the square to the octagon. In the 12th century already appear conical trumpets, as shown in Fig. 2. To avoid the junction of very thin voussoirs forming the trumpet at the vertex of the cone, the stonecutters often placed a semicircular stone instead of that vertex at a; thus they formed a little centering on which rest the intrados of those voussoirs. Such are the trumpets that are still seen on the turrets of the abbey of Chailly (end of 12th century; Fig. 3). Then this first stone placed at the vertex of the reentrant angle at b, and hollowed out in conical form, is called a little trumpet (trompillon).

If it be required, as in the two preceding examples, to obtain a plane at 45 degrees intersecting a right reentrant angle at  $45^\circ$ , the construction of trumpets presents no difficulties. In this case the voussoirs have their extrados traced on a cylinder parallel to their axis, and their intrados on a cone; but if one desires to establish a projecting corner above the reentrant angle, difficulties present themselves. Thus (Fig. 4) taking a reentrant angle A B C on which it is required to place a construction forming the projecting angle A D C, the stonecutter begins by setting a series of corbels on the diagonal B D of the square, (see vertical projection P), and then he will fill the two spaces A D, C D, by means of two skew c





conical trumpets. The second voussoir a will form an abutment to support the projecting angle b. The overturning of the corbels is prevented by the load resting on their tails from d to e and that rises to above the extradoses of the arches.

At the end of the 15 th century, men took pleasure in raising difficulties in stonecutting in order to give a proof of knowledge. The constructors then sought to omit these corbels and to support the salient angles on a reentrant angle or on a cut-off angle by a system of jointing the voussoirs. But then it was necessary for these voussoirs to be cut with side projections, that is a bad method in principle, the stone being no longer loaded parallel to its bed. These are artifices of stereotomy having nothing in common with the serious art of the constructor, and which are made to amuse minds interested in useless problems.

TROMPILLON. Little Trumpet. See Art. Trompe.

TRONE. Throne. See Art. Chaire.

TROU DE BOULIN. Putlog Hole. Art. Echafaud.

TRUMEAU. Pier. Mullion.

This word is generally applied to the entire part of the wall of a story comprised between two openings. Just as a battlement is composed of crenelles, that are the openings, and of merlons, that are the solids, the wall of a habitation comprises piers and windows in each story. The name of mullion is particularly given in the architecture of the middle ages to the piers that divide into two openings the principal portals of great halls, of naves of churches, of crofts, meadows, etc. For the great monumental doorways, the architects of the middle ages only thought of wooden leaves shutting against each other in rebates, presenting a sufficiently solid enclosure. Between these leaves they built a stone pier forming a fixed rebate, a pier in the wide rebate of which engaged horizontal bolts, beams or bars of wood.<sup>1</sup> This method became one of the beautiful motives of the decoration of principal doorways; it also allowed the support of stone lintels below the tympanums, that with rare exceptions were of a single piece.





Note 1.p.315. To these mullions of doorways was also given the name of estouffiches.

We do not find in Greek or Roman antiquity any example of doorways divided by a mullion; it seems that this arrangement exclusively belongs to the middle ages, and only dates from the end of the 11 th century. It permitted the easy establishment of two currents for the multitude at a single opening, without confusion arising from one entering and the other leaving. The portable canopies of wood covered by fabrics, termed "dais", and that particularly in France the clergy caused to be borne over the officiating priest or the bishop in certain circumstances, a canopy that attained the dimensions of a small room, not being able to pass through one of the two openings of the principal portals of churches, the middle mullion was sometimes removed in the last (13 th) century; art objects of great value were thus destroyed. Happily, these mutilations required very considerable expense to support the lintels and tympanums; hence there still exist a good number of doorways equipped with their mullions. One of the oldest and most remarkable is the great doorway of the nave of the abbey of Vezelay. The mullion of this doorway is frankly accented and presents a profile of very beautiful character. <sup>2</sup> The openings are wide; the two lintels of the tympanum above them rest solidly on the two corbels of that central pier (Fig. 1). The statue of S. John Baptist, clothed in a robe of a skin, bearing the lamb in a halo, occupies the axis of the pier; he precedes, so to speak, the assemblage covering the tympanum. At his right and left are figures of prophets, and his feet rest on a beautiful capital. The evident intention of the architect was to leave the widest possible space for the multitude, and to relieve the spans of the lintels by means of those strong lateral projections decorated by figures. When the doors are opened, the effect of this mullion detached against the middle of the nave is imposing. Nothing in antiquity recalls this form and outline of a singular effect. The artist that composed this doorway, and who knew how to profile this mullion, knew his profession. There is no hesitation, the decoration is in perfect harmony with the construction, and in examining this work, the idea does not occur that it could be conceived otherwise. It is rare that the mullions





of doorways have this masterly amplitude. During the 12 th century, they consist only of a pier, that the architect designs as slender as possible not to obstruct passage, and that is habitually decorated by the statue of the divine personage, or of the saint, under whose name is placed the church. On these principles is composed the mullion of the central western portal of the cathedral of Sens (Fig. 2); this doorway dates from 1170 and was restored at the end of the 13 th century. The statue of S. Etienne, patron of the church, decorates the mullion, on the surfaces of which rise ornaments of the best style.<sup>1</sup> The reliefs that decorate the lower part of the pier were mutilated at the end of the last (13 th) century. One sees at the doorway of S. Anne of the cathedral of Paris (right side of the facade) an earlier mullion, on the front of which is sculptured the statue of S. Marcel. Under the feet of that saint is represented the tomb of the damned woman, that served as a habitation for the dragon slain by the holy bishop, whose head is protected by a canopy. The separating piers of the doorways were treated in a far more simple way, when the edifice did not admit of luxurious ornamentation. We give here (Fig. 3) the mullion of the principal doorway of the church of Souvigny, a church of the end of the 12 th century, built with extreme simplicity. This mullion is a rectangular monolithic column decorated by a little column sunk in the panel, and surmounted by two corbels, intended to relieve the lintels.

Note 2.p.315. Art. Porte, Fig. 51.

Note 1.p.317. Art. Sculpture, Fig. 52.

It is certainly by the richness of details that is recommended this piece of stone: still the purity of the mouldings and the elegance of the drawing make one of those works, that please the eyes. The beautiful epochs of the art above the secret of charming by their simplest productions, as well as by their splendid conceptions. When an art has no other resources for pleasing than profusion of sculpture and richness of material, it is judged; it is an art of decadence; if it surprises for a moment, satiety soon succeeds that first impression. Let us again take an example of those simple compositions, that charm only by a happy proportion, a refined study of drawing. Here (Fig. 4) is the mullion of the doorway of the church of the Nativity at Villeneuve-le-Comte.<sup>1</sup> A statue surmounted by a canopy alone





decorates this monolithic column. The arches forming the lintel springs from the pier and enclose figure reliefs, representing the Holy Virgin and the three magi kings. The statue of the bishop rests on a base of rectangular section, whose proportions are studied with much care. One recognizes in the conception of this doorway the hand of one of those masters of Ile-de-France, that knew how to give their simplest compositions the stamp of distinction peculiar to that school.

The churches of Burgundy built during the first half of the 13th century furnish remarkable examples of doorways with mullions. The quality of the materials of that province permits giving a small section to these monolithic piers, and consequently an appearance of lightness not found elsewhere. Unfortunately the iconoclasts of 1793 made a bitter war on all statuary in Burgundy; very few mullions have retained their statues. Yet the composition remains, and that occupies us here in particular. Here (Fig. 5) is the mullion of the central doorway of the church of Semur. This mullion, whose horizontal section is sketched at A, is narrow but deep, so as to support two relieving arches above the two openings. The external part is decorated by a little column with capital and circular abacus, supporting a statue of the Holy Virgin; <sup>1</sup> on the sides of this pier are sculptured the arms of Burgundy and the fleur-de-lis of France, mingled with some delicately treated personages. Two corbels with little figures relieve the lintels, that descend behind the statue, an arrangement imparting grandeur to the composition. This statue was surmounted by a canopy, that was restored about the end of the 13th century, as shown by our Fig. At the church of Notre Dame of Dijon, which dates from the same epoch, and that has many points of resemblance to that of Semur, the mullion of the central doorway is very slender and consists of a little external column bearing the statue, and a second higher little column inside forming the jamb. (See the section, Fig. 6 at A, made at the level of the attachment of the statue). On the shaft of the internal little column is sculptured a head serving as catch for the bolts of the two leaves. This detail in remarkable work indicates the care that artists took in even the accessory parts, as they knew how to foresee the least needs of the construction, and made it a motive of decoration. The stone employed here being of extreme hardness,





the architect reduced the section of the mullion as much as possible. The quality of the materials employed thus evidently influenced the form of these piers dividing the openings of the doorways. Sometimes a holy water stoup hung from the ring inside if this were sufficiently deep to permit the swinging of the two leaves.

Note 1.p.321. From 1230 to 1240.

During the 14 th century, the form given to the mullions of portals was little modified: the principle accepted after the 13 th century persists, i.e., the pier is composed of a lower part more or less rich on which is engaged a statue surmounted by a canopy (Art. Porte). One sees beautiful dividing mullions in the doorways of the cathedrals of Paris, Amiens, Chartres, Bourges and Rouen. After the end of the 14 th century, the mullions do not always stop below the lintels: they intersect the tympanum, present a projecting decoration thereon, that assumes much importance. For example, such are the mullions of the doorways of the facade of the cathedral of Tours, that date from the beginning of the 16 th century, those of S. Eustace of Paris, S. Wulfrand of Abbeville, etc. The Articles Porte a and Tympan render an account of these arrangements, which belong to the end of the 15 th century.

#### TUILE. Tile.

Plates of terra cotta employed for covering buildings. It would be difficult to discover the origin of the tile; the Aryans used this means of roofing before Grecian civilisation, the Dorians made use of tiles and made them perfectly; the Romans scarcely covered their edifices except by tiles or metal, and wherever they passed, one finds a quantity of fragments of the tiles called Roman, whose form is known to all.

The Roman roofing was composed of rows of flat tiles set beside each other, with raised edges and lapping, on the joints of which were placed hollow lapped tiles. The flat Roman, like the Grecian tile, was rectangular in form; its dimensions varied from 15.8 to 13.4 ins. long by 10.6 to 9.1 ins. wide. The longer parallel sides with upturned edges were held by notches made below the edges, at their lower ends. This system required quite difficult work and much care in setting in the kiln. The first centuries of the middle ages continued this procedure of





fabrication well or badly; but it is easy to distinguish tiles made from the 6<sup>th</sup> to the 10<sup>th</sup> centuries, from Roman tiles. Those tiles of the first times of the middle ages are coarse and warped, fit badly and are of smaller dimensions than the Roman tiles. About the 11<sup>th</sup> century were renounced the notches for roofing. In the provinces of the South of France that preserved the antique traditions, a trapezoidal form was given to the flat tiles, so that they could cover without notches, and by the introduction of the small and into the larger one. Fig. 1 explains this system of tile roofing, that we find adopted from the end of the 11<sup>th</sup> century in our provinces of Languedoc and Provence. Relatively to their length, this sort of tiles are wider than the Roman tiles so as to leave a sufficiently open space between the tiles covering the joints, that themselves had to be sufficiently open to cover the space occupied by the edges of the flat tiles. The flat tiles were first laid directly on the rafters as indicated in our Fig., without sheathing. The difficulty in this sort of coverings was to connect at the hips. The hip tiles are easily set on a roof with plane sides, but cannot be fixed on the junctions of surfaces composed of flat tiles with covers. By the aid of mortar, one succeeded in fastening well or badly the hip tiles; but it is unnecessary to state that this means is contrary to the conditions of good construction. The carpentry receiving the tiles is subject to movements produced by changes in temperature; in that case these patches of mortar break, the hip tiles become loose and are overturned by wind. This inconvenience was avoided during the 11<sup>th</sup> and 12<sup>th</sup> centuries, when the edifices were vaulted, by placing very strong hips of stone with projections covering the roofing. The remains of the use of this system are seen in some edifices of Provence and Languedoc, notably on the church of S. Madeleine of Beziers.

Fig. 2 explains the arrangement of those stone hips, <sup>1</sup> terminated at their lower ends by an antefixa A belonging to the first piece, giving weight and bearing to the angle of the cornice. Aa B is traced the section of the hip, and at C its plan, with the positions of the flat tiles and covering projection. The skew tiles were moulded expressly for the place or were simply cut. The space a b being sufficient to receive the flat and cover tiles. On the top of the a sinking e cast the rainwater





on the covering and prevented it from washing the joints, simply filled with cement.<sup>2</sup> If this system of roofing was entirely laid on carpentry without vaults underneath, it was not possible to employ the stone hips given in Fig. 2; those hips must be of terra cotta like the flat tiles. Then for structures built with care were made special hip tiles according to the inclination of the roof. Those ridge tiles were furnished with outlets that received the cover tiles of the slopes (see Fig. 3).<sup>1</sup> Thus one was not compelled to fix these tiles with mortar. One should not omit the gutter tiles placed at the base of the roofs as gutters to receive rainwater, and conduct it to the leaders of terra cotta or to projecting gargoyles. It is unnecessary to state that these gutter tiles were employed only in the most ordinary structures built of brick or rubble. This was one means of collecting rainwater and of storing it in cisterns. The gutter tiles still found in the South and West of France are very large; they measure 25.6 ins. long and at one side have a flange prolonged, that serves to anchor them at the top of the wall beneath the eave of the roof (Fig. 4). It is well understood that these tiles were laid on an inclined plane and thus are farther from the eave of the roof at lower end of the gutter than at its highest point. Therefore this means is only suitable for facades of small extent.

Note 1.p.323. From church S. Madeleine of Beziers.

Note 2.p.323. This system of covering has been employed in a complete manner in the restoration of the roofs of S. Sernin of Toulouse.

Note 1.p.324. From the 12 th century were employed these hip tiles in the southern and western provinces.

About the end of the 12 th century, terra cotta for roofing, tile floors, arches and crestings, attained a very great development. The mode of fabrication was still perfected during the 13 th century. The tile work of that epoch is remarkably good and beautiful. The clays were carefully purified and beaten, are well burned and often in very large pieces.

In the provinces of the North of France after the end of the 11 th century was abandoned the Roman system of tile roofs. Indeed that system is little suited for foggy climates. The dust soon stops the channels, aided by the dampness, develops mosses and vegetation that cover the roofs. By the storms of winter





snow is forced under the cover tiles and rots the carpentry; its weight much increases that of the coverings, already very heavy, and strains the rafters. If the slope is very small, in rainy weather and driven by the wind, water enters between the tiles, that are only covered by a third thickness. If the slope be sufficiently pronounced to ensure discharge of the water, the tiles are loosened by the wind and slip on each other, and it is continually necessary to replace them. Thus a different system is sought for covering with terra cotta, and men commenced by making great flat tiles 13.0 ins. long by 10.6 ins. wide and 0.37 in. thick. These first flat tiles (we say the first, because these are the earliest that we have been able to find, and whose manufacture dates at the end of the 11 th century) appear to have been much in use in Burgundy and in a part of Nivernais during the 12 th century. They are quite flat, with the top edge bent downward forming a continuous hook. This hook (Fig. 5) rests on large strips of wood almost forming a sheathing (see A). At Cluny, Macon and Vezelay, are still found this sort of tiles long out of use and used as broken tiles or thrown among the rubbish that fills the spandrels of vaults of old edifices.

Note 1.p.326. Art. Charpente.

But the province in which tiles seem to have been studied with most care is Champagne. There are the ordinary tiles and those tiles called tiles of count Henry. The first is 13.3 by 8.4 ins. These tiles (the oldest dating in the 13 th century) are pierced by a hole and have a hook underneath. We shall explain why. The rafters are set with spaces equal to them. When to be covered by tiles, these rafters are 4.2 ins. thick (weak), leaving between them a space of 4.3 ins. But they are not of equal depth (Fig. 5 bis): the main trussed rafters are 5.5 ins. (5 to 6 ins): the intermediate rafters are only 3.2 ins.: see A.

The distance on centres a b c was then 3.7 ins (weak). On those rafters were nailed oak strips spaced 4.5 ins. apart. Now the tile (see B) as we have stated, has a hook e beneath and a hole t, each at one third the width of the tile. Then when the workman desired to cover with them, he fastened the tile on the lath so that the hole should come on the rafter, and then drove a nail or even a wooden pin through the hole and entering the rafter. The holes being sometimes at the right, sometimes at t





the left, the rows of superposed tiles always had the holes and the hooks on the same line, i.e., the hooks on the laths and the holes on the rafters. (See at C a portion of the roofing with the tiles shown as placed in order, and at C' the geometrical drawing of the roofing before setting the tiles). These tiles that are still frequently found on the edifices of Champagne, and particularly at Troyes, are very well made, the hooks well fixed with side flanges (see B). They are slightly convex on top and lie close to the slope and allow no hold for the wind. The hooks project 0.6 in. These are always found between the rafters and hug the laths closely; the tile would already be held of itself without the roofer having to touch it. He could then drive the nail or pin into the hole, entering the solid wood of the rafter. We have stated that the spacing on centres of rafters was 8.7 ins (small). Now the tiles being 8.4 ins, leaving 0.3 in. play between the tiles, one sees that the width of these tiles corresponded exactly to the spacing of the rafters on centres. It is understood that a roofing so made must be durable, the tiles being of excellent quality. The sight of these tiles is only 4.5 ins. Now these tiles being 13.8 ins. long, there are always on the roof three thicknesses of terra cotta plates. The thickness of these Champagne tiles is 0.37 in. Tiles of trapezoidal form were made for the part of the roofing along hips, and likewise today the tile makers of Champagne are still held to furnish these skew tiles without extra cost.

Let us see what were the dimensions and form of the so-called conut Henry tiles (Fig. 6). This tile is smaller than the former and is generally glazed on the sight, i.e., from a to b. Its lower edge b is beveled to give a more uniform covering and leave no hold for the wind. Its hook is well cut with a knife with a small notch above, so that the roofer can feel with the hand without turning over the tiles of the row that he is setting. These last tiles are laid on smaller rafters than those of ordinary tiles, and sometimes on strong strips set almost close together, leaving only space for the hook. Then the nails are driven into these strips without paying any attention to the rafters. <sup>1</sup>

Note 1.p.329. With these glazed tiles were covered the cathedral of Troyes, so as to form a mosaic of red, black and yellowish white.





The tiles of count Henry are made with still more perfection than the ordinary tiles of Champagne. One will note that the hole is larger and square underneath. That was done to prevent the nail from splitting the tile, if it were rocked by the wind, or when the tile was nailed on sheathing. This enlargement then left a certain freedom to the tile (Fig. 6, 7).

The ridge tiles of these coverings of flat tiles are likewise made in great perfection; they were held on the framing of the hip of the carpentry by nails or pins, and often made solid by a hook fixed outside on the top of the hip (Fig. 7). Valley tiles were made as well as those for hips, except that they did not bear hooks, and that naturally their concave surfaces were on the exterior. As for crestings, we have devoted a special Article to them. (Art. Fautiere).

One sees in Champagne and in Burgundy (especially a tile country) tiles with hooks, whose visible corners are cut off and beveled like those of wooden tiles. These sorts of narrow tiles are glazed on the sight, and are chiefly made for covering conical roofs (Fig. 8). In fact wide tiles cannot fit this sort of roofs, and their angles being tangent to the curve give much hold for the wind and produce a bad effect. To cover conical roofs with tiles, it is necessary to change the widths of the tiles every four or five courses, according to the diameter of the base of the cone and its height, so as to always break joints. For that purpose the tile makers of the middle ages made tiles of different widths and gave them the form of a trapezoid more or less tapered (Fig. 8). The roofer must give the tile maker the forms of the tiles, when the roof was drawn, which was easily done. It was also for the roofer to profit by the different widths of tiles, to harmonize the joints and arrange that in each row, they should fall at the middle of the tiles of the lower row.

In some provinces of the Centre, on the banks of the Loire, in Nivernais and Poitou, men also about the end of the 12<sup>th</sup> century made flat tiles in the form of scales.<sup>1</sup> These tiles were narrower than the tiles of Champagne and Burgundy, are sometimes glazed on the sight, and have three grooves that aid the running off of the water (Fig. 9). They are pierced by two holes and have a hook beneath, that rests on the head of the lower tile, and was placed on a sheathing. These sorts of tiles





are thick (the clay of those provinces not being very hard), and have not resisted atmospheric agents as completely as the tiles of Champagne and of Burgundy. All tiles whose forms and dimensions have been given were moulded by hand on sand and cut with a knife, not made in moulds, like most fabricated modern tiles; their burning (with wood) is regular and complete. Old tiles in Burgundy are unchangeable and are as good today as at the time of laying them. The glazing that covers them (especially the dark brown glaze) and the transparent coating that accents their red tint have resisted time. Yellow and green glazes have been most changed. In the provinces of the northeast, in Flanders, were employed after the 15 th century tiles in the form of an S, still in use today and known under the name of Flemish (Spanish in U. S.). These tiles are only good for light roofing, that does not have to absolutely protect the parts underneath. In great winds, they allow rainwater to enter and are easily disturbed. From an early epoch, perhaps the 13 th century, men ceased to employ in the ordinary works of the southern provinces the flat tiles with joint covers given in Fig. 1. They contented themselves with using hollow tiles, i.e., tiles forming covers and by inverting them, replacing the flat tiles. This kind of covering is still used in the entire South of France beyond Lyonnais, in Auvergne, a part of Limousin, Perigord, and ascending into Vendee: it is not without inconveniences. The hollow tiles being moulded on sand, the sanded part is found in the hollow. This sandy surface receives all the rainwater and is more porous than the convex surface; it retains wet, catches dust, and develops vegetation that fills the hollows and requires frequent cleaning. This mode is only good in countries where the heat of the sun is strong enough to prevent this vegetation from forming. In adopting the system of flat tiles for roofs with steep slopes, constructors in the North evidently recognized the inconveniences of the antique system and its derivatives, viz:- the persistence of dampness in the carpentry and the growth of mosses in the hollows of the roofs. The care with they fabricated these flat tiles, the use of glazing to prevent the penetration of moisture and the growth of the mosses, the system of fastening, indicate that the masters like true architects did not disdain these important details of construction. The flat tiles given in Figs. 5 bis and 6 emphasize





the intelligent foresight of those constructors of the 13<sup>th</sup> and 14<sup>th</sup> centuries. It is to be noted that this industry of the tile makers only decreased after the end of the 15<sup>th</sup> century until the beginning of the present (19<sup>th</sup>) one. The tiles of Burgundy and of Champagne made during the last (18<sup>th</sup>) century are relatively coarse and unequally burned, and it is only within a dozen years that men have occupied themselves in France with that very interesting part of the art of building. We have been driven into that new path of the use of terra cotta for roofs by our neighbors, the English and the Germans, that have preceded us, or rather that have not ceased to practise those useful industries, generally disdained among us by artists, too much preoccupied by their grand conceptions, and scarcely practical enough to enter into these minor details of construction.

#### TUYAU. Art. Conduite.

#### TYMPAN. Tympanum.

The solid portion comprised between the arch of the doorway (archivolt) and the lintel. The name of tympanum is given to the solid surfaces between the extrados of an arch and the band over it. The surface A (Fig. 1) is the tympanum of a doorway; the surface B is the tympanum (spandrel) between two arches. The tympanums of doorways being placed on a lintel can be made in various ways; composed of small materials as a filling, or of large surfaced blocks of stone decorated by paintings or reliefs. It also occurs that the tympanums of doorways are opened and have transom windows, but this arrangement was scarcely adopted till after the middle of the 13<sup>th</sup> century, notably in the monuments of Champagne. The place occupied by the tympanum under the archivolts of the doors was particularly favorable to sculpture. In that position the reliefs could not fail to produce a great effect, and (protected as they were by the projection of the arches or porches) did not have to fear the destructive action of rain and frost. Many of our churches still retain magnificent sculptured tympanums: (Art. Porte). Among the most remarkable dating from the 12<sup>th</sup> century, we shall cite those of the doorways of Vezelay, of S. Benoit-sur-Loire, of Charlieu, the western portal of the cathedral of Chartres.





portal of S. Anne of Notre Dame of Paris, central portal of the cathedral of Senlis; among those of the 13 th century, the tympanums of the lateral doorways of the cathedrals of Chartres and of Rheims, the portals of the cathedrals of Paris, Amiens, Bourges, etc. Until about the beginning of the 13 th century, the tympanum of a doorway, if sculptured, rarely comprised more than one subject; sometimes if very great, it consists of two zones, as one can see on the central portal of the Virgin of Notre Dame of Paris, rarely of a larger number. Dating from about 1240, the tympanums generally consist of several zones. Subjects are superposed and multiplied, or rather are enclosed in architectural compartments. Statuary thus loses its magisterial importance, and it is subjected to a smaller scale. For the very broad system that consisted in placing a lintel with its sculpture of a great relief above it, was substituted a series of superposed lintels (Art. Porte), several bands of reliefs with figures smaller in scale as those superposed lintels are multiplied. In the 14 th century the sculptures of the tympanums are more and more absorbed by the geometrical forms of architecture. About the end of the 15 th century the mullions project from the tympanums by statues and pinnacles, that extend even to the crown of the archivolt. The mullion is then no longer a support, but a sort of buttress, a very ornamental pier that divides the doorway, its lintel and tympanum, into two parts.

In spite of the rigidity of its principles, the architecture of the middle ages (and one has occasion to recognize it in the course of this work) avoids monotony and commonness, what is termed pattern in the language of the arts. Rarely does one find in the conceptions, even the commonest, those botches or insignificant fillings, so frequent in the monuments that we erect today at great cost. The luxury of the materials and exaggeration of expense do not compensate for lack of invention and poverty of idea; our masters of the 12 th and 13 th centuries appear to have been fully impressed by that truth. Thus while remaining subject to the fundamental principles of their art, they knew how to deduce the most varied results; th therefore the most attractive and most novel in the eyes of the people.

In Art. Poste we give very numerous types already arranged in





very varied fashion; but we are compelled here to follow the method and to exclude the exceptional cases, that however furnish precious examples of what real genius knows how to derive from the reasoned application of a true principle. We shall proceed with one of those examples, as must have proceeded an architect of the 13<sup>th</sup> century, so as to make understood the critical method of those masters, to whom cannot be refused knowledge and modesty, for which we do not have the courage to reproach them.

Note 1.p.334. Few architects of the middle ages in France inscribed their names on the monuments that they erected, contrary to the custom of their Italian colleagues. This indifference or excess of modesty has been made their reproach by a celebrated critic as a confession of inferiority. Still it would seem that it is the work that must be judged, and that the name of its author has nothing to do with the matter.

It is known that to relieve the lintels of doorways, the architects terminated the jambs by corbels that diminished by their entire projections the spans of those monolithic lintels (Fig. 2). Although these lintels A were relieved by the archivolts B, yet they still had to bear the tympanum C; sometimes they broke under that load, especially when they were not made of resistant stone. If instead of the corbels D, we place two stone brackets E abutting at F, it is evident that the lintel is completely relieved, and that its height between beds can be much reduced for the benefit of the tympanum. By reasoning thus, the architect author of the south doorway of the church S. Severin at Bordeaux must have proceeded (Fig. 3). The lintel of this doorway is actually reduced to the height of a band. Below, the corbels are replaced by a trefoil arch with spandrels covered by a delicate sculpture of vines in the midst of which birds are playing. An inscription giving the date of this doorway (1247) surrounds the trefoil arch. Above on the lintel is placed the sculpture of the last judgment; then in the upper tympanum is Christ seated on a throne and showing his wounds, assisted by two angels bearing the instruments of the passion, and implored by the Virgin and S. John. On the voussoirs are bands of leaves, martyrs and virgins. On the splayed jambs and developed laterally between the little columns in the height of the spandrels of the arch, are the apertles, the Church and the Synagogue.





This doorway is accompanied by two blind arches with tympanums in which are represented scenes from the life of S. Severin. The entirety of that composition given in Fig. 3 is very remarkable and produces a great effect. At A we present at large scale one of the spandrels of the trefoil arch, in a design both original and graceful. Its sculpture is flat like embroidery, but is delicately treated, and must have produced all its effect, before this doorway was sheltered under a later porch. The programme is further that of many church doorways; yet one sees that the architect by this development of the corbels supporting the lintel, has known how to derive from it an entirely new method. Did not the author of the doorway of S. Pierre-sous-Vezalay likewise derive a new mode of composition of the tympanum of the central doorway (art. Porte, Fig. 65), then suppressing the lintel and replacing it by a development of the corbels? Later, about the end of the 14th century, the lintels supporting the tympanums were frequently replaced by segmental arches. The corbels were thus suppressed; these segmental arches rest on the jambs and on the mullion with a pronounced projection and placing its crowning before the tympanum, most frequently perforated and filled with glass. Subjects in full relief that usually fill the tympanums of the 12th century thus give place to a transom filled by glass. As we have stated, Ch Champagne first adopted this method after the 13th century. The doorways of the westery facade of the cathedral of Rheims prove this. In this case the lintel supports an actual window with its colored glass instead of reliefs. Yet it seems that the arrangement of solid tympanums decorated by subjects in full relief is preferable to these windows. In fact the voussours decorated by statuettes form an enclosure, a sort of help to the principal decorative subject of the tympanum; if this tympanum be empty, these rows of voussours no longer have any reason from the point of view of iconography. The masters of the best period in Ile-de-France so understood it. But the beautiful iconographic conceptions already changed in the adjacent provinces after the middle of this century, and architects often no longer admit sculpture as a motive of decoration, without occupying themselves too much with the unity of the general compositions. We do not make this a reproach to them, for in the religious edifices that we erect, it is rare that the





statuary from the studios of different artists executed on separate orders presents an iconographic entirety directed by one idea. Admitting that each figure or each relief may be a masterpiece this defect in the general conception, this lack of unity in intention produces a very sad effect. It must be stated that the clergy being scarcely familiar with these questions and occupied with other interests, perhaps more important from the religious point of view, no longer gives those beautiful programmes of figures, that are so complete and so broadly conceived in the great churches of the royal domain from 1180 to 1240. Their taste no longer led them to love the beautiful and serious statuary so well arranged during our best period of the middle ages. The pretty, slightly heavy, imagined in the 16th century by the school of the Jesuits, or the Italian style of the late Renaissance, always dominates in the minds of those persons, who by their position in the Church could contribute to restore to the works of religious statuary the virility and beautiful style, that they have lost.

Yet some of those compositions of tympanums of the 15th century do not lack grandeur. Among others, we shall cite the tympanums of the principal portal of the cathedral of Tours, which dates from the end of that century. That of the central doorway (Fig. 4) is tracery, with a sort of double lintel or rather double imposts and segmental arches. The middle mullion projects the statue, its canopy the archbishop's cross above it in front of the glazed window. Thus we repeat, as a mode frequently adopted at the end of the middle ages and until the 16th century. In our Art. Porte is found a very great number of compositions of tympanums, so that it is not useful to emphasize here the decorative system of these members of the architecture of the middle ages. We shall only say a few words of the spandrels of arcades between their archivolts. Ornamental sculpture or statuary plays an important part in these spandrels, usually of small dimensions. These sculptures are made to be seen near, are treated with love and are skilfully composed in view of the places they occupy. Very remarkable spandrels of arcades are seen; on the portals of the church Notre Dame la Grande of Poitiers; at the cathedral of Angoulême (12th century); on the S. Chapelle of the palace at Paris; on the portals of the cathedrals of Paris, Bourges and Auxerre (13th century); in





the chapels of the nave of the cathedrals of Bordeaux and of Laon (14 th century) etc. (Arts. Ange, Arcature, Autel, Cloitre, Sculpture, Triforium). When these tympanums are of small dimensions, they are filled by fanciful animals.

#### UNITE. Unity.

In every art conception, unity is certainly the primary law, that from which all others are derived. In architecture that law is perhaps more imperious than in the other arts of design, because architecture groups all those arts that compose an entirety with them to produce an impression; architecture tends to a supreme result; to satisfy the need of mankind. The idea of the artist in composing any edifice whatever, must never lose sight of this end to be attained, for it does not suffice for its composition to satisfy materially this need, it is necessary for the expression of that need to be clear; now this expression is the visible form, the grouping together of all the arts and the industries to which the architect has recourse to perfect his work. The more complex a civilization, the greater the difficulty to compose according to the law of unity; this difficulty increases with the mass of the knowledge of preceding arts, of traditions of the past, from which the thought of the artist cannot be diverted, that obsess him, impress his judgment, and so to speak, carry his pencil into grooves already traced.

One of our predecessors, whose writings are justly esteemed, has said:- "Thus it is necessary for a monument to emanate from a single mind, which combines its entirety in such a manner, that without changing the harmony, one can neither omit nor add anything to it, nor change anything." <sup>1</sup> One can say it better, but it will be understood that it is difficult for an architect to fulfil that programme, when to express his idea, he must draw from very different sources. We freely recognize that many architects in our days do not admit the law of unity, that they deny its power and extol a sort of vague eclecticism, allowing the idea of the artist to seek in the past, at the North or South, suitable expressions to give a form to that idea. These artists declare that from that mingled heap of documents will arise the architecture of the future. Perhaps; but while waiting, that of the present only most frequently expresses disorder





and confusion in ideas.

Note 1.p.346. Quotremere de Quincy. Dict. d'Arch. Art. Unite.

We are not of those, who deny the utility of the study of former arts, since it is given to no person to forget or to cause to be forgotten the long series of the traditions of the past; but what every reflecting mind must do with that mass of materials is to place it in order, before thinking of utilizing them. What does one do that inherits a rich library, if not at first to classify its elements in methodical order, so as to be able to use it on the day when he needs it? It is again essential, that after this first classification, he makes at least an analytical summary in his head of each work in the library, in order to select and profit judiciously by his choice. Among all architectlural styles that merit being mentioned in the history of the world, not one does not proceed according to the law of unity. On what is based that law of unity? That is what it is proper to investigate firs. The needs that architecture proposes to satisfy are very varied. It is always necessary to shelter man, either as a family or an assembly, and to allow him under this shelter to devote himself to his occupations, or to fulfil functions more or less extended, according to whether his social condition is more or less complex. If these primary conditions differ little, the mode of satisfying them is wery variable. Indeed the shelter may be made of wood or of stone; it may be excavated in tufa or fashioned in the earth; it can be composed of parts juxtaposed or superposed; it can have a temporary purpose or defy the effect of time. Then art interwenes and the law of unity is established, naturally because everything in the created order exists only by unity of intention and conception. One desires to build a wooden cabin and fells trees; unity of intention. One combines those trees by u utilizing their properties; unity of conception. Whatever one may say or do, then first on construction is established the law of unity in architecture, whether this concerns a wooden hut or the Pantheon at Rome. Nature has never proceeded otherwise, and it is more than rash to seek laws outside those it h has established, or rather to relieve ourselves from those laws, we that form a part of them. Discoveries in the physical sciences show us daily with more evidence, that if the order of created things manifests an infinite variety in its expressions,





it is subject to a number of laws more and more restricted as we penetrate farther into the mystery of movement and life, and who knows if the last limit of those discoveries will not be the knowledge of one law and one atom! In brief, creation is unity; chaos in the absence of unity.

On what shall be established the law of unity, if not on the structure, i.e., on the means of building? Would it be on taste? But in architecture is taste anything more than the proper use of the means? Should it be on certain forms adopted arbitrarily by a people or a sect? But then if we have beside those forms other forms arbitrarily adopted by another people or sect, we shall have two unities. We see the architecture of the Hellenes perfectly conformed to the laws of unity, because that architecture never falsifies its means of construction; likewise among the Romans, (concerning monuments built in the Roman manner); also among the western peoples in the middle ages during the 12<sup>th</sup> and 13<sup>th</sup> centuries. Yet those monuments are very unlike, and they are unlike because they obey the law of unity based on construction. The mode of construction changing, the form necessarily differs, but there is not a Greek unity, a Roman unity, or a unity of the middle ages. An oak does not resemble the stem of the fern, nor a horse a hare; yet plants and animals obey the organic unity, that governs all organized individuals.

In fact, unity can only exist if the expressions of that art are derived from a natural principle. Unity cannot be a theory or formula; it is a faculty inherent in the universal order, and that we likewise see adopted as well in the movements of the planets as in the smallest crystals, in plants as in animals. M. Quatremere de Quincy in his *Dictionnaire d'Architecture*<sup>1</sup> distinguishes in the art of architecture "different sorts of partial unities, from which result the general unity of an edifice." That author thus arranges what he terms partial unities, but without defining what a partial unity may be.

Note 1.p.341. Quot. de Quincy. Dict. d'Architecture.

"Unity of system and of principle.

Unity of conception and of composition.

Unity of plan.

Unity of elevation.

Unity of decoration and of ornament.





Unity of style and of taste."

The illustrious author of the Dictionnaire d'architecture does not tell us how unity of system differs from unity of conception, nor how those two unities can be separated from the unity of style and taste; how the elevation of an edifice, that seems to be derived necessarily from the plan, still possesses its unity distinct from that controlling the composition of the plan. We think that unity possesses that quality of not being divisible, and what can be divided is plurality. That column of six unities (and we do not see why that number is retained) precedes the paragraph in which it is stated, that unity of system and of principle does not permit placing arches on columns, nor a Corinthian capital on an Ionic column. This seems to be a very solemn preamble to a slender conclusion. Yet farther on the author of the Dictionnaire, in reference to the unity of elevation, writes these lines that cannot be submitted too much to the reflections of the architect; "What particularly constitutes in architecture the unity of elevation, is first such a correspondence of the exterior of its mass with the interior, that the eye and the mind perceive there the principle of order and the necessary connection, that have determined the mode of existence. The principal purpose of a facade or elevation of a building is not to present combinations or compartments of forms that amuse the eyes. There as elsewhere the pleasure of the view, if it does not proceed from a need or a reason of utility, far from being a source of merit and of beauty, is no more than a brilliant fault. But there as elsewhere, the greater number is mistaken in the transfer of ideas, i.e., in subordinating the need to the pleasure. Hence that multitude of elevations of edifices, whose forms, combinations, arrangements, orders and ornaments, contradict the principle of unity based on the nature peculiar to each thing. What is then important to the unity of which we speak, is not that an elevation may have more or less parts, more or less ornaments, but that it may be such as willed by the kind, nature and purpose of the edifice; that this corresponds to the reasons, constraints and needs, that have determined its internal arrangement; that the exterior of this edifice may be combined by the visible bond of unity in the manner that the needs of the interior have required." Happily, we do not have to harmonize the opinions of the former





perpetual secretary of the Academy of Fine Arts with the teachings derived from the architectural works left by the past and present members of the learned assembly. those are family affairs; we only show that this definition of the unity of the elevation at bottom may be applied to architectural works, without its being useful to divide that unity. To never deceive at need, in the arrangement imposed by that need, in the means that furnishes the material of the work, in the requirements of construction, these are the first conditions of unity in architecture, and these conditions cannot separate the plan from the elevation, the conception from the style. <sup>1</sup> We no longer conceive an architect as making a plan without foreseeing the elevations given by that plan, than we could conceive shadow without light, or light without shadow. Further, what does one understand by unity of plan? Is it that each part of the edifice projected on a horizontal plane has the necessary dimensions, that these may be placed as these are expressed, that they fully satisfy economy, durability, orientation, internal and external appearance? That each part cannot be arbitrarily enlarged, dimensioned or changed, without the result of something less good? That the solids be not in accordance with what they must support, and that the mode of building be in harmony with the materials to be employed and with local customs? If that be what is meant by unity of plan, it is very good, in our opinion; but we cannot comprehend the conception of a plan so drawn without the simultaneous conception of the elevations; for to take matters in fact, the plan is only the horizontal projection of what is termed the elevation; now how can one conceive and draw that horizontal projection of something to be created, and that does not exist? But if by unity of plan is meant an image traced on paper according to certain symmetrical principles, a sort of embroidery design pleasing the eyes by certain balancing of masses, of solids and voids, otherwise torturing the requirements to be satisfied by every edifice, so as to render this image more agreeable, then we confess to not understanding that unity; but we comprehend that this unity can be distinct from the unity of elevation, since it has nothing to do with the requirements to be satisfied, with the mode of building, with the nature of the materials to be employed, with economy and good sense, that seem to order nothing to be done in architecture, that does not





have a reason for existence and cannot be justified.

Note 1.p.343. See Arts. Gout, Style.

There is one sole means of giving unity to an architectural work; this is that the programme and the forces being known -- we mean by forces the resources in men, money and materials, -- to find the combinations that permit satisfying this programme, and of employing those forces in a manner to make them produce the most complete result. It is evident, that if to satisfy his fancy the artist devotes a notable part of the resources at his disposal to one point of an edifice for producing an effect to the detriment of the others; that if his edifice presents specimens of all means of construction and of ornamentation from a love of eclecticism; that if he deceives in the construction furnished in his time to imitate forms belonging to a past fashion; that if the monument erected by him has no connection with the customs of the time; if he shocks those manners by arrangements belonging to a different civilization or another climate, his waste cannot pretend to unity.

Unity alone exists when there is an intimate relation between the architecture and the object. A Doric temple presents a type of architectural unity; but if you make of a Doric temple an exchange or a church, the unity is destroyed; for to appropriate that edifice to a purpose different from that for which it was erected, it is necessary to torture its arrangements and to destroy what constitutes its unity.

We cannot repeat too frequently, that only by following the order that nature itself observes in its creations, one can in the arts conceive and produce according to the law of unity, which is the essential condition of all creation. If in the order of created things, one has sometimes believed that he saw deviations from the principle of unity, a more profound study has always shown that on the contrary the exception confirms the rule, and it is one of the glories of modern science to have joined by observation more and more the universal organism to the law of unity, which cannot and does not prevent that organism from being infinitely varied.

We say, proceed the same in architecture; start from the principal one, have but one law, truth; always truth, from the first conception to the final expression of the work. We add, that here is an art, the Hellenic, that proceeded thus at its





origin and had left immortal works; there is another art under a different civilization our own, in another climate, ours, the art of the French middle ages, that proceeded so at its origin and has left immortal works. Yet these two expressions of unity are dissimilar. Then it is necessary to proceed according to the same law to produce an art.

With blind persistence, which often gives to a defect of understanding the defect of bad faith, men repeat to us: - you pretend to cause us to adopt today the forms adopted by the masters of the middle ages; why those rather than others? All are good to us, and all can serve us, for all belong to the domain of humanity. We reply; the objection starts from a primary idea lacking analysis. Since the 16<sup>th</sup> century we have taken in France forms produced in architecture by the application of the principle of unity in certain conditions, for unity itself, without referring to the law from which result those forms. Men have believed that they satisfied the conditions of unity because they more or less faithfully adopted certain forms of architectures preceding our time, forms that were the results of the principle of unity, but which because being the consequences of a principle, are not the principle. Those that have had the habit of proceeding thus, i.e., of taking the form without taking into account the principle that produced it, cannot admit that one could proceed otherwise; and seeing us study and analyze the applications of the general law made by the masters of the middle ages they admit that we must proceed as those did, i.e., that taking the form and merely the form in relief of the architecture of the middle ages, we regard this form as our preferred unity, and that henceforth we should have that claim to prescribe the use of that form.

To be clearer, let us resort to a comparison that each can understand. In inorganic nature beneath our eyes, there is an innumerable quantity of crystals, that are the result of a law of crystallization. To reproduce the relief appearance of those crystals in any material, or to establish physical or chemical conditions by the aid of which those crystals can shape themselves under the empire of the general law, are two very distinct operations. The first is purely mechanical and merely gives the result without import; the second places an attribute of creation at the service of human intelligence. The question is





then reduced to its most striking expression; to copy in any material whatever crystals, that are the product of a law regulating crystallization; or to seek the law, so that by applying it there result naturally the crystals suitable for the material employed. To find that law necessarily requires one to define the properties of these crystals, to analyze their substance and the conditions under which they take the form that we know for them. And would one be well received in the domain of science by saying to a chemist, that seeks the law of crystallization, that he pretends to cause us to live in a geode?

Unfortunately, what is not permitted in the domain of science, is allowed without scruple in the domain of architecture, because of the obscurity long thrown over that art and its principles. Architecture is not a sort of mysterious initiation; like all the products of the mind, it is subject to principles that have their seat in human reason. Now reason is not multiple, but is one. There are not two ways of being right in a proposed question. But the question changing, the conclusion given by reason is modified. If then unity must exist in the art of architecture, this cannot be in applying a certain form, but by seeking the form, that is the expression of what reason prescribes. Reason alone can establish a bond between the parts, put everything in its place, and give the work not only cohesion, but the appearance of cohesion, by the true succession of the operations that must constitute it. However large a part one desires to leave to the imagination, there is only the way traced by reason, for constituting a form. Geniuses have never proceeded otherwise, and their works only charm us, because they take possession of our minds or hearts, in passing by way of our reason.

Our monuments of the middle ages especially possess unity: 1, because they fulfil exactly, scrupulously and servilely, the given programmes, and which are thus the most vivid expression of the civilization within which they were built; 2, because their form is only the combined result of the means employed; 3, because all their parts are conceived in a manner to satisfy the needs for which they were erected, and to ensure their stability and duration; 4, because their decoration proceeds according to a logical order and is always subject to the construction; 5, because that construction itself is sincere, that it





never conceals its procedures and employs only the forces necessary.

Our monuments of the middle ages do not have six units, but they have unity. The Articles of the Dictionnaire sufficiently emphasize this quality, we believe, so that it may not be necessary to extend farther on its importance.

#### VANTAIL. Leaf of Door.

A leaf of joinery turning on hinges or pivots, and closing the opening of a doorway. It was customary in Grecian antiquity often to hang the leaves by means of two pivots on the muntin or stile of the rebate. Those pins entered two round holes made under the lintel and at the end of the threshold. This primitive procedure required the leaf to be set in constructing the doorway. One still sees leaves so hung at the doors of monuments in southern Syria, that date from the 4<sup>th</sup> and 5<sup>th</sup> centuries. It is necessary to know that those leaves are of stone, (generally basalt), and that it was impossible to hang them otherwise, since one could not attach hinges. Yet this method was applied in Gaul to wooden doors, and we find that tradition retained until the end of the 16<sup>th</sup> century it for rustic structures, notably in Nivernais and in Auvergne.

Those primitive leaves consist of a hanging stile A (Fig. 1) made of a branched tree, so as to make the upper rail B of the same piece. This upper rail enters at C a strike stile D, that also receives the tenon E and a bottom rail. Thick planks are pinned on this frame, that is only visible in the interior. The two pins a and b enter cylindrical holes a', b', made in the sill and in a stone belonging to the jamb. There is not a nail in that construction; the whole is held by wooden pins. This sort of leaves is generally doubled, and the strike stiles stop at the sill and on the upper lintel of wood. They were fastened inside by a wooden bar entering the notches G pinned on the end stiles. There is every reason to believe, that this form of leaf belongs to the Gauls, since one still finds in the private structures of the Gallo-Roman epoch, traces of these cylindrical holes intended to receive the pins of the stiles. It is readily understood that this rude means of hanging the leaves was defective. The pins of wood turned hard in the holes b' in the stone; if the doors were very large in dimensions, it was neces-





necessary to employ much force to swing the leaves. From the Gallo-Roman epoch hinges were in use, since they are still found, and that means of hanging doors was generally adopted after the Carlovingian period. (Art. Serrurerie). However the leaves were composed of members on which were generally laid bands, if the doorways were of sufficiently great dimensions.

The system of relief to prevent the leaves from sagging, i.e., from deflecting in their width under their own weight, is always adopted; men even sometimes used during the 12<sup>th</sup> century branched timbers to form these braces, or at least one of them; and the iron hinges are either visible on the exterior on the planks, or are set between them and the frame, as in the example given here (Fig. 2), which is taken from a door of the old church of S. Martin of Avallon. One sees in this Fig. presenting one of the leaves seen inside, that the hanging stile A is cut from a branched tree. Boxings B and C are cut in that stile to receive the feet of the braces, that relieve the end of the top rail D and the strike stile E. The short brace G connects this stile and the bottom rail H. The iron hinges are placed between this frame and the external boarding, which only shows the pins holding the braces and the heads of the nails fastening them to the hinges. This work was rude and yet was very well understood from the point of view of stability and use. Soon the execution became more refined, and the leaves received various sorts of external decorations, either by the attachment of hinges of wrought iron, by coverings of finely wrought bronze, or by paintings, heads of nails, plates of bronze or of wrought iron. These decorations habitually depend on the construction. Thus for example in Fig. 3, that we give here, <sup>1</sup> one sees that the system of construction of the leaf, composed of a lattice between the stiles and rails, externally reproduced on the boarding by a lattice of narrow mouldings (see detail A), beaded and with nail heads at the intersections. Those nails pass through the mouldings as indicated by profile B at C. The heads of the nails are ornamented by an ornamental washer of wrought iron. (See G). As in the preceding example, the hinges are set between the framework and the boarding. It is well understood that the framework is inside. The lattice mouldings are nailed on the boarding and correspond to the bracing lattice. The boards are thus maintained perfectly by the ornamental system, and t





the nails consolidate the halved latticed braces. These wooden bars crossing both ways and nailed together cannot yield, and the stability of the work is complete. This decoration applied externally on the boarding is not always a reproduction of the framing; it often consists of mouldings nailed on according to certain geometrical compartments, as the Arabs practised from all times with forms borrowed from architecture, such as bands, arcades, gables, etc. <sup>1</sup> One still sees on the leaves of the western doors of the cathedral of Seez applications of this kind, that represent a sort of grille composed of rows of finely made little arcades. The rows of arcades are six in number in the height of the leaf, including the crown (Fig. 4), and are simply nailed on the boards that they keep flat. At A is traced the detail in section of one of these arcades with its little column, at B being a section of that. The little columns, their capitals and rings are turned. The rows of arches are cut in a plank and nailed, as indicated by our sketch. All that decoration was painted in strong colors, as well as the ground.

Note 1.p.349. Taken from the leaves of the cathedral of Coutances, and from the door now destroyed, that was seen beside the church of Mont-S.-Michel-en-Mer, 13 th century.

Note 1.p.350. Art. Menuiserie, Pl. 12.

There is found in Art. Menuiserie a very great variety of these decorated leaves, both by applications and by combinations of joints. <sup>2</sup> We do not think it necessary to enlarge further here on works in wood.

Note 2.p.350. Art. Menuiserie, Pl. 12.

It also occurred that the leaves of doors were covered by plates of metal, bronze or wrought iron, this being independent of the hinges. <sup>3</sup> One still saw on the left doorway of the western facade of the abbey church of S. Denis at the beginning of the last (13 th) century, leaves of doors brought from Poitiers by Dagobert, and that were covered by perforated plates of bronze representing scrolls with animals. These leaves had been replaced on that facade at its reconstruction by abbot Suger, as works worthy to be preserved. <sup>4</sup> The monks of the chapters destroyed a good number of these precious objects since the reign of Louis XIV, and the revolution of 1792 cast into the crucible what remained, so that today in France only with great difficulty have been found some traces of those leaves





covered by metals more or less skilfully decorated. Some remains of wrought iron have alone escaped these devastations because of their small value. Doors of treasuries and of shrines yet allow their coverings of wrought iron to be seen. Those coverings are always made of bands of iron, for sheets were not made then; only by the hammer could one obtain thin iron of small dimensions. These bands were most frequently placed as lattices with a nail at each crossing. Fig. 5 represents one of those leaves covered by crossed bands of wrought iron connected by a nails with rosettes forming washers. At A is given one of those rosettes, at B is the section with the crossed bands, and at C is the section of the edge border.<sup>1</sup> This sort of leaves have only moderate dimensions. In Fig. 5 between the crossed bands is seen the wood, but it was not always so; ornaments of wrought iron were cut out and sometimes placed in the intervals of those bands (Fig. 6); they form rosettes held at the centre by a nail and by bands, under which were pinched their ends. Thus the wood of the leaf was almost entirely covered by a solid armature composed of a rich ornamentation. The fragment that we give appears to date from the 14 th century, and comes from the collection of drawings of the late Garneray. The leaves were also horizontal boards placed to lap. Those bands were plain or were cut out in the form of scales or of lambrequins (Fig. 7), held on each other as indicated by section A and by strong nails penetrating the wood. This leaf was attached to a door of the abbey of S. Bertin at S. Omer.<sup>2</sup> It likewise appears to belong to the 14 th century. Thus (except the ornaments) were habitually covered the leaves of the posterns of cartles, and sometimes even of private habitations. Men most frequently contented themselves for the doors of houses and mansions with heads of nails more or less wrought (Art. Clou), set in quincunx or according to the rails or braces on which were attached the boards.

Note 3.p.350. See some examples of these hinges in Art. Servurerie.

Note 4.p.350. On the old strike stiles of the church, that king Dagobert caused to be built, this was inscribed in very old interlocked letters, quite difficult to read. (Latin inscription). D. Doublet, *Antiq. et rech. de l'abb. de S. Denys en France*. Book I. Chap. 33.





Note 1.p.352. There still exist leaves of this kind at Sens and Rouen (cathedrals). We have seen them in many churches, from which they were removed twenty years since, probably because of their decayed condition. The example given here was drawn by us in a storehouse of old iron at Rouen.

Note 1.p.353. Without any indication of its origin.

Note 2.p.353. Drawing in collection of Garneray.

As we have already stated above, there remains to us in France no trace of leaves of mediaeval doors covered by bronze; yet several churches possessed them. Dom Doublet speaks of the doors made according to the orders of abbot Suger for the western facade of the new church. It seems that those doors were very richly decorated by sheets of bronze gilded and enameled. "He caused to come" (Suger), says Dom Doublet, "several founders and experienced sculptors, to ornament and enrich the strike stiles of the principal entrance doors of the church, on which were seen the passion, resurrection, ascension and other stories (with the representation of the said abbot prostrate on the ground), the whole being cast; and which was proper to be made at great cost, both for the metal, and for the gold that was also employed for the stiles of the door at the right hand on entering, that he caused to be enriched by metal, gold and enamel, leaving the old stiles of the third door at the left hand, that were from the first building of the church." The inscription in verse appeared on the bronze of the principal doorway. We transcribe it here from Dom. Doublet. (Latin poem).

Note 3.p.353. *Antiq. et rech. de l'Abb. de S. Denis en France.* Book 1. Chap. 23.

And on the lintel over the leaves. (latin poem).

If the Latin is mediocre, the ideas are very beautiful and very appropriate to the object.

In the absence of all graphical documents, we do not seek to give a restoration of this monument that would be so interesting.

One knows the beautiful bronze doors of the Norman basilica of Monreale near Palermo, of the cathedral of Pisa, and of Verona. Those leaves consist of panels in which are placed subjects in low relief with niello and damascined work. It is to be presumed that the leaves of the principal doors of the abbey church of S. Denis were conceived in the same manner. One also sees on the southern side of the cathedral of Augsburg leaves of doors cov-

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covered by bronze in panels, that dates from the 12 th century, but contain fragments taken from a much older monument. If one refers to certain vignettes of manuscripts, he could also believe that the middle ages placed on the leaves of doors bronze coverings in horizontal bands like superposed strips, decorated by ornaments and figures.

As for wooden leaves framed in panels, we refer the reader to Art. Menuiserie.

#### VERGETTE. Iron Rod.

A small square or round iron rod, that serves to support the glass panels between the crossbars. The glass panels are attached to them by means of small strips of lead soldered to the leads of the glass. (Art. Vitrail).

#### VERRIERE. Stained Glass Window. (Art. Vitrail).

#### VERROU. Bolt. Art. Serrurerie.

#### VERTEVELLE. Catch. Art. Serrurerie.

#### VERTU. Virtue. (Figure).

The iconography of the middle ages frequently placed in parallel the personifications of virtues and vices. The antagonism of good and evil, as all know, is one of those ideas accepted among nearly all peoples of the superior races. We see it manifested in the Vedas, among the Iranians, the Egyptians, and during pagan antiquity. Semitic monotheism must necessarily reject that double influence, that was the foundation of pantheism, so to speak. The Jews accepted no power as a rival to their Jehovah. For the Jews, sin was only an infirmity attached to man, but was not assumed to be inspired by a power superior to him. It is true that Genesis makes the serpent interfere between the first man and the first woman; "the serpent was more wily than all the animals of the earth that the eternal God had made; he said to the woman, etc." In that example is nowise a question of a rival power, of the spirit of evil. The serpent gives perfidious advice; it stated that a spirit had assumed its form, that he had an interest in it, that he must profit by it; no spirit advised Cain to slay his brother. The Eternal, seeing





Cain dejected when his sacrifice is rejected, says to him:-  
 "Certainly if thou dost well, thou shalt be considered; sin besets thy door, it desires to reach thee, but thou canst master it." <sup>1</sup> For the Greeks as for all peoples of Aryan race, evil was a natural force like good, a rival force, necessarily conquered but immortal, fighting without truce, independent and venerated on account of its divine quality. Man was only a sport between these two powers, invoking the intervention of the good against the acts of the evil, but never believing that his personal will could struggle against the latter. Pantheism -- we speak of the primitive pantheism based on the observation of natural phenomena, and not of the enervated and superstitious pantheism of the later times -- regarded the action of the divine forces as acting well above frail humanity, as engaging in contests and exerting its power in a sphere far superior to human interests. Man was fatally subject to decrees, whose motives he could not penetrate, and if he invoked the gods, this was never with the hope of their modifying in his favor the course of affairs. Semitic egoism admits that Jehovah stopped the progress of the sun to allow Joshua to crush his enemies; one finds no analogous legend in the entire religious history of the Aryans. For them the forces of nature act in the fullness of their independent power. A divinity can struggle against the sun, but cannot command it to stop in its course.

Note 1.p.355. Genesis, Chap. 3. Translation by Cohen.

Note 2.p.355. Genesis, Chap. 4.

This preamble was necessary to explain a philosophical phenomenon produced in the Christian iconography of the West, about the end of the 12 th century. Then the artists were evidently inspired by the ideas of the time, and did not absolutely cause the spirit of evil to interfere; they admitted the good and bad qualities inherent in man, and personified them. This is a limited pantheism in the human soul instead of having the universe as its seat. It is evident that the word pantheism here cannot entirely express our thought; men do not adore Charity or Courage but personify them; give them a body and attributes, sometimes even a halo; and if they do not worship these metaphysical abstractions, the multitude comes to regard them as forces possessing a sensible form of divine emanations. It must further be stated, that if the virtues are personified, the vices in





opposition to the virtues are represented by an act and not by a personage; at least this is the most general case. Before the lay school of the end of the 12 th century, the virtues like the vices are represented by acts taken from the Scriptures. In the representation of vices the devil always intervenes; he advises and presides over the execution of the evil deed, while the spirit of evil no longer appears in the representation of vice opposed to virtue, after the end of the 12 th century. Thus on the jambs of the central portal of Notre Dame of Paris are carved in the medallions 12 virtues, represented by 12 women bearing certain attributes; the vices in contrast are sculptured beneath those medallions, and are represented by scenes. Examples; Faith is placed next at the right of Christ and bears a shield filled by a cross. Below a man kneels before an idol. Courage is the first virtue at the left of Christ and is clad in complete armor; a coat of mail over her robe, helmet on head, a buckler on her left arm, on which is a lion rampant, a naked sword in her right hand. Beneath is Cowardice, a man fleeing from a hare; he turns around frightened and drops his sword.<sup>1</sup>

Note 1.p.357. Here are the virtues represented on these jambs with the vicious acts opposed to them. -- On the right of Christ:-- 1, Faith. Below the adoration of an idol. -- Hope, a dropped woman bearing a standard on her shield. Below a man transfixed by his sword. -- 2, Charity, holding a sheep on her lap, figure mutilated. Below, Avarice holding a purse and locking bags in a coffer. -- 4, Justice, a salamander covering her shield (figure destroyed). -- 5, Prudence, her shield bears a serpent coiled around a staff. Below a wandering man with rent garments, holding a torch in his right hand, and in his left a horn; this is Folly. -- 6, Humility, on the shield an eagle lighting. Below, Pride represented by a man on a fiery horse, that casts him off backward.

On the left of Christ:-- 1, Strength. -- 2, Patience, an ox on her shield. Below, Anger, a woman with flying hair chases a religious with a stick. -- 3, Meekness, a lamb carved on her shield. Below, Harshness, a crowned woman seated on a throne kicks a suppliant kneeling before her. -- Harmony, her right hand unrolls a scroll on which she looks; her left holds a crotchet on which is engraved a lily and an olive branch. Below, two men





ore fighting. -- 5, Obedience, a kneeling camel is seen on her shield. Below a man makes a gesture of contempt before a bishop that exhorts him. -- 6, Perseverance, a crown suspended in the shield. Below a religious leaves his monastery. (See Description de Notre Dame de Paris, by M. Guilhaume and Viollet-le-Duc. 1856).

Only about the end of the 12 th century, as we previously stated, appear on our monuments these representations of the virtues, and among those sculptures may be cited as the oldest, those that decorated the base of the left doorway of the facade of the cathedral of Sens. They show ~~Man~~Manificence, opposite being Avarice. Manificence (Fig. 1) is a draped woman, crowned and seated. With her hands she opens two coffers filled with bags of crowns. Two lamps in form of crowns are supported beside her; at her feet are two vases of flowers. Avarice (Fig. 2) is one of the beautiful sculptures of that epoch (about 1170). With hair flying under a piece of cloth, the left hand bent, she is seated on a coffer that she has shut violently with the right hand; under her feet are bags filled with crowns. Avarice is personified here. <sup>1</sup> (Old French poem).

Note 1.p.358. Thus a troubadour of the 13 th century describes manificence and Avarice. (Old French poem).

William Durand states that the virtues are represented under the forms of women, because they nourish and caress men; <sup>1</sup> But again the artists of the middle ages gave them an energetic and militant character. In the stained glass of the great western rose window of the cathedral of Paris, the virtues are armed with lances and fight the vices, sometimes represented by historical personages. Sardanapalus represents Folly; Tarquin, Licentiousness; Nero, Iniquity; Judas, Despair; Mahomet, Impiety, etc.

Note 1.p.360. Latin note.

At the cathedral of Chartres the artists of the 13 th century have given to the representations of the virtues the most complete development. There <sup>2</sup> the virtues are not opposed to the vices, but extend on foot on the voussoirs, and are divided into three rows; public virtues and private virtues. The virtues of the private man are placed on the inner voussoirs, the virtues of the public man are on the outer voussoirs; on the intermediate voussoirs are sculptured the domestic virtues. Each series contains 14 figures, commencing with the right hand vous-





voussoir. At Chartres the public virtues present great iconographic interest. The first has lost its title; its buckler is charged with roses. Didron<sup>3</sup> regards it as personifying Memory. The second (Fig. 3) represents Liberty; her shield is charged with three crowns; she holds a lance in her right hand. The third is Honor; her shield is charged with mitres. The fourth has lost her title but is Prayer, according to Didron; in fact on her shield is sculptured an angel holding a book. The fifth is Adoration; the angel holding a censer charges her shield. The sixth is Promptness; three arrows charge her shield. The seventh is Courage; on her shield is a lion rampant. The eighth is Concord; her shield is charged by a pair of doves. The ninth is Friendship, with the same arms. The tenth is Power, an eagle holding a sceptre charges her shield. The eleventh is Majesty; three sceptres on her shield. The twelfth is Health;<sup>1</sup> three fishes are on her shield. The thirteenth is Security, a keop on her shield. The fourteenth has an effaced inscription, but is designated by Didron as being Religion; a dead dragon on her shield; a living dragon (symbol of the demon) beneath her feet. This figure holds a standard, and we should more willingly designate her as expressing Faith. All these statues hold lances, crosses or standards in their right hands, are crowned and haloed. The sculpture is in a beautiful style; their bearing is proud, the heads are expressive and the draperies arranged with art. let us state in passing that Liberty and Promptness or Activity, if you prefer, are regarded as virtues of the first rank, public virtues; and we frankly confess that in the middle of the 19th century we should not place them on our churches. Could we even sculpture them on our civil edifices? We represent there Abundance, Justice, Industry, or again, Religion, Charity, Faith, Hope, and we give them a famished and slightly silly appearance, that in our times is regarded as the attribute suited to these personifications. The works of our artists of the 13th century seem to us truer, more vigorous and more sane. No one is ignorant that most critics, who by chance desire to say a word on the arts of the middle ages, wilfully confuse schools and epochs without having taken the trouble to examine the products, even for a single day, and reproduce this stereotyped idea with objections, viz:— that the sculpture of the middle ages is ascetic, puny and oppressed by an enervating





theocracy. We have no desire to see society return to that time, if that were possible; but we wish that our artists would show in their works, and in the idea that directs them, something of that virility so profoundly impressed on the French statuary of the 12 th and 13 th centuries. In regard to religious sculpture, men seek today to satisfy us by some pale idea, blanched, unhealthy and lifeless, a sort of compromise between insipid traditions badly understood, and a classical canon; while we find in that statuary of our architecture of the 13 th century, overflowing with sap, a need of freedom of the mind that strengthens the heart and pushes the spirit forward. It must be of little importance to us that then the bishops were feudal lords, and that the feudal lords were petty tyrants, if under that regime the artists knew how to elevate the moral side of man to prepare virile generations. Those artists were then in advance of ours, who are too careless of their dignity and submit to the degenerate and senile traditions of the Academy, or the faded religiosity of the sacristies, without daring to express an idea of their own. If the execution in our days is beautiful, so much the better, but it is only a vestment that must cover a living idea, not mannequins from a withered Olympus or the oratory of devotees. Certainly the statuaries of the middle ages made much religious sculpture, or at least attached to religious edifices, since a great number were erected. Yet whether this depended on them or on the inspirations that they obeyed -- they never descended to those debasing tricks or those platitudes, that are given out today as religious art. The virile sculptures of Chartres, Rheims, Amiens and Paris are proofs of this. It suffices to see them without having made its decision in advance.

Note 1.p.360. Latin note. (Rot. div. off. Book I, Chap. 3).

Note 2.p.360. Voussoirs at left side of north porch.

Note 3.p.360. See Didron's very interesting Article on the Virtues of Notre Dome of Chartres. (Ann. Arch. Vol. VI, p.35.).

Note 1.p.361. Health is a gift and not a virtue; but it is evident that the word Sanitas is to be understood here in a moral sense. It is the health of the mind that is meant, not physical health.

In the 13 th century the Church did not reject from the portals of its edifices these civil virtues, Courage, Activity,





Manificence, Liberty, Justice, Friendship, mental Health; near these were represented daily Labor, as at Notre Dame of Chartres; below them are the vices; then the sciences, arts, mental labors. Thus is completed the encyclopedic cycle, that the French cathedral exhibits to the people, as far as permitted by the state of the sciences of that epoch.

In brief, the Church was then alive and was worthy to live, since it entered into the social movement, that tended to constitute a great nation on the borders of western Europe. Its first virtue was to be truly national, to press forward intellectual developments. Whether it could have repented of this; whether feeling itself outrun by minds too advanced according to its views, it would have attempted to arrest the movement, that it had itself aroused in the midst of the dioceses, it is no less certain that it then took the initiative, that the arts felt this, and that those arts could not be regarded as enervated, suffocated beneath a mischievous and petty theocracy.

The virtues were not only represented on the portals of churches; they had their places also on the portals of palaces, in the great halls of castles and on the facades of mansions. The knights sculptured on the towers of the castle of Pierrefonds, on those of the castle of Ferte-Milan, are personifications of heroic and warlike virtues. Those figures gave their names to the towers. Thus at Pierrefonds the knights are eight in number, like the towers. Those statues 9.8 ft. high and of beautiful work, are those of Cesar, Charlemagne, David, Hector, Joshua, Godefroy de Bouillon, Alexander and of king Artus.

On the facade of the palace of the Chambre des Comptes built by Louis XII opposite the S. Chapelle of the palace at Paris, were seen four statues of the virtues, which were Temperance, holding a clock and a telescope; Prudence, holding a mirror and a sieve; Justice, having as attributes a balance and a sword. Courage, that held a tower and choked a serpent.<sup>1</sup> The combat of the virtues and vices was the subject of many paintings and tapestries, that decorated the halls of castles. Romances and inventories frequently mention this sort of hangings designated by the name of moralities.

Note 1.p.263. Dubreuil. Antiq. de Paris. Book I.

VIERGE, SAINTE. Holy Virgin.





# VIERGE, SAINTE. Holy Virgin.

About the middle of the 12 th century the worship devoted to the Holy Virgin assumed a particular character in France. Until then the sculptured or painted monuments give to the Holy Virgin a secondary place; she is the woman designated by God to give birth to the Son. She is an intermediary, a divine means, but does not participate in the deity. If in the 12 th century that dogma did not change, the arts singularly modified its meaning, and it is well understood, that the arts are only an expression of popular sentiment, that exaggerated or exceeded the dogmatic idea. In causing their cathedrals to be rebuilt in the North of France about the end of the century under an essentially lay <sup>1</sup> inspiration, the bishops believed these should abound in the religious minds of the people. Most of those great edifices were placed under the name of Notre Dame; and the place assumed by the mother of God had an importance entirely novel in the religious iconography. At Notre Dame of Senlis, the story of the Holy Virgin occupies the principal portal; at Notre Dame of Paris two of the portals were reserved for representations of the Virgin, that on the left of the western facade, and that of the south transept. At Rheims the statue of the Holy Virgin occupies the mullion of the middle portal. At Notre Dame of Chartres one of the portals of the 12 th century is consecrated to the Virgin, etc. The popular sentiment already tended to regard the Virgin as a quasi divine personage, only caused it to be believed. Churches and chapels without number were erected to the mother of the Saviour. Statues abounded not only in religious monuments, but at street crossings, at the corners of houses, on the facades of mansions, on the gates of cities and castles. The representation of Christ before that epoch was admitted to the motives as a divine personage, visible and tangible, while that of the Father was very rarely reproduced (Art. Trinite). That was further conformed to the Catholic dogma; it was natural to represent the Son of God, since the Father had desired him to descend on earth and to become man.

Note 1.p.364. Art. Cathédrale.

For example, one sees on a great number of Christian sarcophagi of the 5 th to the 8 th centuries that Christ is represented in the midst of the apostles in the form of a young and





beardless man. The Father is represented in these sculptures only by a hand projecting from a cloud. As for the Virgin there is scarcely any question, or if she appears, she occupies an inferior place, even less than that of the apostles. In that the artists conform to the letter of the evangelists. The Virgin begins to take a prominent place only when the crucifixion is represented, i.e., in the West about the 8<sup>th</sup> or 9<sup>th</sup> century. Then according to the text of the evangelist of S. John, she occupies the right of the cross and S. John the left. In the scenes of the last judgment of the beginning of the 12<sup>th</sup> century, as for example at Vezelay and a little later at Autun, the Virgin does not appear, while we see her kneeling on the right of her Son and praying for mankind, in the scenes of the judgment dating from the beginning of the 13<sup>th</sup> century.

But before that epoch, i.e., about 1140, she is already seated on a throne and holding the infant Christ between her knees. She is crowned; adoring angels cense the divine Infant. We also see the Virgin represented thus on the portals of the right side of the facades of the cathedrals of Chartres and of Paris, in the tympanums of doorways that date from that epoch.<sup>1</sup> Fig. 1 reproduces the Virgin of the cathedral of Paris, better preserved than that of Notre Dame of Chartres, but similar in pose and attributes. The mother of the Saviour holds the Infant in her lap with her left hand; with the right she holds a sceptre terminated by an iris fruit, she has a halo like Christ; he blesses with the right hand and holds the book of the gospels in the left. The execution of that figure, much larger than nature, is very beautiful, and the heads have a character quite approaching that of archaic Greek sculpture.

Note 1.p.325. It is necessary not to lose sight of this, that the tympanum of the right portal of the western facade of Notre Dame at Paris comes from the church of the 12<sup>th</sup> century built by Etienne of Garlande, and was replaced in the construction of that facade at the beginning of the 13<sup>th</sup> century.

There is seen in the baptistery of S. Valerien at Rome a painting, that does not seem earlier than the 9<sup>th</sup> century, and that represents the Virgin holding the infant Jesus in her lap; she is not crowned, but her head is covered by a very simple blue veil over a white hood. The Infant holds a roll in the left hand and blesses with the right in the Grecian mode. (See





gatacombes de Rome, by l. Perret. Plate 83).

This mode of representing the Holy Virgin was borrowed from Greek artists; it was a Byzantine importation due to the ivories and paintings, that in great number were brought from the Orient by the crusaders. In those painted or sculptured representations, it is evident that Christ, by the place occupied, and by his gestures of blessing, is the principal personage; that the Virgin, however revered, is there only as a supporter, the woman chosen to bear and care for the Son of God. The middle of the 12 th century does not leave that arrangement, and one still sees in the abbey church of S. Denis a Virgin in wood of that epoch, taken from the priory of S. Martin-des-champs, which exactly reproduces that attitude.<sup>2</sup> The Greek archaism, by which these art objects are impressed, could no longer suit the lay schools of the end of the 12 th century. One again sees the Virgin seated and holding the divine Infant in the middle of her lap (on the axis), according to the Greek fashion, in some edifices of the beginning of the 13 th century, as at the cathedral of Laon, and as at one of the north doorways of Notre Dame of Rheims; then that is all. From that epoch the Virgin is no longer represented as seated and holding her Son in her lap, except in the scenes of the adoration by the Magi. If she occupies an honorable place, she is standing, crowned and triumphant, holding her Son on her left arm, a branch of lilies (aram) or a bouquet in the right hand, or indeed she extends that hand as if to grant a gift. Her face is calm and she looks forward; to her is the homage addressed: Christ is an infant, that in the earlier monuments still blesses with his right hand and holds a sphere or a book in his left hand, but who later passes his right arm behind his mother's neck and plays with a bird. The face of the mother smiles and sometimes turns toward the head of the Child. She is the mother in particular, the woman clothed with a divine character, and indeed she is addressed by the multitude: it implores her, believes in her all-powerful mediation, and the Child is only in her arms to indicate the origin of that power.

Note 2.p.325. There are many other examples in France, both in statuary and in glass, that likewise date from the middle of the 12 th century.

It is well understood, that we do not pretend here in any





manner to discuss the dogmatic question; we merely render an account of the transformations, that were the result of the lay intervention in the representation of this portion of the sacred iconography. The movement of religious minds toward the worship of the Virgin, acquired during the 13<sup>th</sup> century an importance, such that sometimes the high clergy was moved by it; but it was not possible to go to meet it. Men in their prayers rather addressed the Virgin, because in the eyes of believers she was always the compassionate mediator, always indulgent and always heard between the sinner and divine justice. One conceives that this sentiment was for artists and poets an inexhaustible source of subjects. That also suited the French mind, that does not love absolute doctrines, desires alleviations of the law, and freely believes that by the mind, a happy turn or good sentiment, one can cause all to be pardoned.

For the people the Virgin had again become a woman, with her spirit, persistence, active love and tenderness of heart, always finding a means of disengaging one from the worst case, if only implored a little with fervor.<sup>1</sup> In the legends of the miracles due to the Virgin, so numerous in the 13<sup>th</sup> century, sometimes poetic and sometimes puerile, there is always a Gaulish side. With a mild and refined dignity the Virgin knows how to cause the devil to fall into his own snares. Artists in particular seem to possess the privilege of exercising the indulgent care of the mother of Christ; musicians, poets, painters and sculptors also emulate in rendering a homage, to which as a woman she could not remain insensible.

Note 1.p.387. See the legend of Theophilus (Rutebeuf). Also see the *Livre des miracles de la Vierge*, manuscript in the library of the seminary of Soissons.

Always present where her intercession can save a soul or prevent a danger; requiring little, so as to find more frequent occasion of showing her inexhaustible charity; her counsel, when she sometimes gives it, is simple and never based on recriminations or threats. Such is the Virgin as shown to us by the legends and poems, whose image the sculptors and painters have endeavored to retrace. It will be agreed, that there is one of the most touching creations of the middle ages, and which illuminates the darkest pages.

The Virgin further possesses the privileges of divinity, for





it is by her own motion, and without recourse to her Son, that she accomplishes her merciful acts; she seems to be provided with the most extended power over the things of this world. Extending thus, the worship rendered to the Virgin became a motive of innumerable works of art. The statues of the Holy Virgin made during the 13<sup>th</sup>, 14<sup>th</sup> and 15<sup>th</sup> centuries are counted by hundreds in France, and many are very good, yet those among these statues that date in the first half of the 13<sup>th</sup> century must be regarded as being in the best style. The end of the 13<sup>th</sup> century and the beginning of the 14<sup>th</sup> have left us several of those works, that from the point of view of grace and the most elegant and refined naturalism are masterpieces. We shall cite the statues of the north portal of the cathedral of Paris,<sup>1</sup> that of the so-called portal of the gilded Virgin at Amiens, a Virgin of oriental alabaster (cathedral of Narbonne); a Virgin of marble (half natural size) in the abbey church of S. Denis, etc.

Note 1.p.368. Art. Sculpture, Fig. 24; see the head of this statue

To make understood these transformations of the image of the Holy Virgin toward naturalism, we give in Fig. 2 that of the portal on the right of the western facade of Notre Dame of Amiens, which dates from the end of that century. The first figure is serious, and it extends the hand as a sign of conferring grace. The Infant blesses; his pose is calm and dignified, like that of his mother. The second is entirely occupied with the Child, on which she smiles. The first has the appearance of a divinity; she receives homage and seems to respond to it; she crushes with her foot the head of the dragon with a woman's head, and on the pedestal supporting her are represented the birth of Eve and the fall of Adam. The second statue is a charming mother, that seems to have no other care than to caress the Infant carried on her arm. On examining the two works of sculpture, one measures the distance passed over by the French artists in the space of a century. What they lose in style and the religious idea, they gain in grace, already a little mannered, and in naturalism. The execution of the statue of the gilded Virgin is marvelous. The heads are modeled with an infinite art and a charming expression. the hands are of an elegance and a rare beauty, the draperies are excellent. But this Virgin is





a noble lady entirely happy to be occupied with her infant, and does not seem to be attacked by that languor, that a certain school of critics believes to gratify the statuary of the middle ages. No more dragons under the feet of the gilded Virgin of Amiens; her halo is richly ornamented by stones and rounded flutes, supported by three little angels of charming work.

During the middle ages, the Virgin is not represented without the child, except in legendary subjects where she directly intervenes, or in the scene of the assumption. But then she holds in her hand the book of gospels, as if to always connect her with the life of Christ. All somewhat enlightened amateurs know the charming sculpture of Notre Dame of Paris representing the assumption,<sup>1</sup> and which we have reproduced here in the principal part, i.e., the figure of the Virgin. Six angels raise the halo of clouds that encloses the figure, two others cense at the height of the head. The veil of the mother of the Saviour is coiled in the upper part of the cloudy halo. The Virgin is deprived of her crown at the moment when her body is raised by the angels, since this apotheosis succeeds the coronation by the Son, who stands at her right. The coronation of the Virgin is very frequently represented, both in sculpture and in painting. This is one of the subjects loved by the artists of the 13<sup>th</sup> and 14<sup>th</sup> centuries. The cathedral of Paris possesses two that are very remarkable; that of the left portal of the western facade, which dates from the first years of the 13<sup>th</sup> century,<sup>2</sup> and that of the so-called red doorway on the north side, which dates from about 1260. One also sees on the tympanums of the cathedrals of Senlis and of Paris very beautiful reliefs representing the death of the Virgin. Christ is present at that scene and receives the soul of his mother in his arms.<sup>1</sup>

Note 1.p.371. This sculpture forms a part of the reliefs, that formerly ornamented the cloister of Notre Dame, and that one still sees on the walls of the chapels of the chevet on the north side. It dates from the first years of the 14<sup>th</sup> century.

Note 2.p.371. Art. Sculpture, Fig. 16.

Note 1.p.372. The litanies of the Virgin are sometimes represented on our churches; they are seen sculptured in one of the 16<sup>th</sup> century chapels of the curious church of Ferte-Bernard.

The number and nature of the vestments given to the Virgin by the artists of the middle ages are not changed from the 12<sup>th</sup>





to the 15 th centuries. The difference is only in the manner of wearing these vestments, that always consist of an ample and long under robe rising to the neck, with close sleeves and girdle, and a mantle and a veil on the hair and beneath the crown. This veil falls on the shoulders to the middle of the back.

During the 12 th and 13 th centuries, the mantle allows the front of the robe to be seen, and is draped more or less amply over the arms; but about the end of the 13 th century, the mantle extends from one arm to the other across the front, and covers the robe, of which one only perceives the top of the lower border.

The colors given to the vestments of the Virgin are red and blue; red and sometimes white for the robe, white for the veil and blue for the mantle. The embroideries represented in gold on these fabrics are, the lion rampant of Judah within a circle, small fiche crosses, and the heraldic rose.

#### VIERGES, SAGES ET FOLLES. Wise and Foolish Virgins.

The parable of the wise and the foolish virgins is sculptured in a great number of our religious monuments. In our cathedrals, the wise virgins are almost always sculptured on the jamb of the principal doorway on the right of Christ; the foolish virgins being on the left jamb. Below the wise virgins, who are generally five in number, is represented a leafy tree, and below the foolish virgins in equal number, is a tree with its trunk chopped by an axe. At the cathedral of Sens, the jambs of the principal doorway possess their collection of virgins, that date from about 1170, although the statue of S. Etienne may be raised on the mullion; but all leads to the belief, that this statue of S. Etienne was placed there after the fall of the southern tower, at the moment when after the fall, there must remain a good part of the western facade, and that the tympanum of the principal portal was rebuilt. As for us, this statue of S. Etienne occupied the mullion of the right doorway before the ruin of the tower. Its position on the central mullion entirely deranges all the iconography of the older portion of that doorwan, built accompanying the statue of Christ.

At the cathedral of Amiens are seen the wise and foolish virgins sculptured on the jambs of the central doorway, at both sides of the Christ; likewise at Notre Dame of Paris. At the cathedral of Strasburg the wise and foolish virgins are sculp-





sculptured, not in reliefs on the jambs, but occupy the splays. These are charming statues, <sup>1</sup> that date from the beginning of the 14<sup>th</sup> century.

Note 1.p.373. Left doorway of the western facade. (Art. Sculpture, Pl. 25).

Those statues of the wise and foolish virgins are especially interesting to study, because they minutely represent the costume of the women of the time when they were sculptured; but it is unnecessary to believe that all statues of the middle ages reproduce the clothing of the epoch in which they were made. If some legendary personages, saints of the diocese, bishops, religious and donors are clothed in the costume worn at the time when sculptured, the Virgin, apostles, personages of the Old Testament and those mentioned in the New Testament, are clothed according to a tradition, whose origin is found in the first Christian monuments and among Byzantine artists.

#### VITRIL. Stained Glass Windows.

We are no longer in the time when serious persons pretended that glass was unknown to the Greeks and Romans. All European museums today possess glass objects, that date from high antiquity, and which in perfection of manufacture are nowise inferior to what Byzantium and Venice sold to all Europe during the middle ages.

Asians and Egyptians obtained glass pastes of various colors, and Gaulish tombs yield articles of copper or gold with settings of bits of colored glass, bracelets, beads and collars of vitrified pastes.

Romans employed glass to fill the windows of their habitations. Did they set colored glass in window sashes? We know that they employed naturally translucent materials, alabaster, talc and gypsum, which admitted a tempered light to the interiors of apartments or monuments; but until now there have not been discovered panels of antique glass composed of glass of different colors.

It must be stated, that in the monuments of the Romans and of ancient Greece, windows were small and scarce. In large edifices like the Baths, for example, daylight was habitually softened by lattices of metal or marble without glass. The vastness of those interiors and the well chosen orientation permitted t





the use of this method without injury by the effect of the external air; the more so since those openings were pierced at a great height, and that they affected the air moving in the lower parts only as a means of ventilation. Besides the Romans and the Greeks were accustomed to live in the open air, the climate of Greece and of southern Italy not requiring habitual precautions against cold.

But if one cannot affirm that the Greeks and Romans in antiquity employed colored glass in windows, it may be admitted that Aryans possessed this mode of translucent decoration from a remote epoch. To be dated from the relations of Rome with Asia in the introduction into Italy of mosaics composed of cubes of colored glass pastes. When the empire was established at Byzantium, from the Orient came those vases of colored glass so greatly prized in the West from the 7<sup>th</sup> century. Things change little in the East, and the lattices of stucco or marble enclosing bits of glass of different colors, that we see in monuments of the 13<sup>th</sup> and 14<sup>th</sup> centuries in Asia and even in Egypt, must be a very ancient tradition, whose origin appears to be in Persia.

Whatever may have been those origins more or less distant, colored glass in abundance was made in the West from the 12<sup>th</sup> century, and the monk Theophilus belonging to that epoch presents the means of manufacturing these objects as being no novelty. On the contrary his text indicates long practice in that kind of translucent painting, and the stained glass windows that we still possess, dating from that century, are so perfect in execution, that one must assume a long experience for obtaining that development of an industry, whose processes are tolerably complicated.

It is singular, will be objected, that there remains not a single panel of authentic colored glass from before the 12<sup>th</sup> century, while we still possess objects much preceding that epoch. But when one knows with what facility we allow things to perish, that are no longer in fashion, and how easily glass is destroyed as soon as removed from its place, this objection loses much of its value.

Of all the stained glass transferred during the French revolution to the museum of French monuments, what remains? A dozen panels at S. Denis, some at Ecoen and Chantilly, and those are all.



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Note 1.p.374. Knowing that much of this stained glass was transferred to the storehouses of S. Denis after the dispersion of the museum of Petit Augustins, when we were charged with the restoration of the abbey church, we inquired where this glass was placed. We were shown three or four boxes containing thousands of bits of glass piled therein. Scarcely three pieces remained joined by leads. The boxes are still awaiting the fairy willing to unravel that chaos.

It is then necessary for us to take up the art of the glass worker at the time that the monuments appeared, i.e., about 1100; and it may be said that the monuments of the 12 th century are the most remarkable, if this art can be considered from the decorative point of view.

The book of the monk Theophilus is the most ancient written document on the manufacture of stained glass, that we possess, and this cleric lived in the second half of the 12 th century;<sup>1</sup> at least the recipes given by him and the taste in ornamentation prescribed by him appear to indicate that date.

Note 1.p.375. Diversorum artium schedula.

Theophilus wrote his book as a practitioner, not as a theorist; thus it now has a serious interest for us, the more that the processes indicated by him exactly agree with the monuments remaining to us from that epoch. Thus it is necessary to analyze those documents. He commences<sup>2</sup> by giving the method of designing the glass.

Note 2.p.375. Book II, Chap. 17.

"First," says he, "make a flat table of wood of such width and length, that you can draw on it two panels of each window." This table is covered by a coat of whiting mixed with water and rubbed with a cloth. After this preparation dries thoroughly, the artist draws on it the subjects or ornaments with a lead or tin point; when the drawing is completed, he traces an outline in red or black with a brush. Between these lines the color of each piece is indicated by a sign or letter.

Pieces of suitable glass are successively placed on the table, and the principal lines, those of the leads are traced on the glass, which is then cut by means of a hot iron and a flat piece of steel with slotted edge.<sup>3</sup>

Note 3.p.375. The diamond now replaces the hot iron with advantage.





Theophilus does not clearly state whether he indicates on the table (that we now call the cartoon) the complete modeling or the figures or ornaments. He speaks only of the drawing; yet when he takes up the painting, i.e., producing the modeling on the cut pieces of glass, he says that it is necessary to follow accurately the lines on the cartoon. This passage naturally explains itself, if one examines how the stained glass of the 12 th century is painted.

On these pieces of glass the modeling is nothing but a series of lines in the sense of the form.

We shall soon return to this important point of the art of the glass painter.

Theophilus <sup>4</sup> indicates the recipe for producing grisaille, (gray glass), the modeling, the drawing repeated on the glass. All who have closely examined stained glass made during the 12 th and 13 th centuries know that the glass employed is colored in the paste, and that the modeling is only obtained by means of black or brownish-black painting applied to this glass with a brush and vitrified by fire. This is the black color mentioned by Theophilus in his Chapter 19. He there composes it of thin copper burned in an iron vessel, green glass and of Greek sapphire. Was this a natural or artificial substance, a flux or an oxide? There is every reason to believe, that Greek sapphire was a bluish glass from the Venetian shops, that had a fluxing property. Indeed the Venetian glass possessed that quality in a degree much superior to our ancient glass. These three substances are ground on a slab of porphyry, mixed in equal parts; i.e., one third copper, one third Greek sapphire, one third green glass, and diluted with wine or urine. This color is placed in a pot and applied with a brush, either light, darker, or thick, to make black and fine lines; or indeed it is spread on the glass in a thin coat and then removed with a wooden point to form very fine ornaments, or touches detached in light on a dark ground, yet still translucent.

Note 4.p.375. Book I, Chap. 19.

The glass being thus prepared is placed in the oven to vitrify this monochrome painting. According to Theophilus, it will be by the aid of copper oxide that this brown color will be obtained. Yet the pieces of painted glass of the 12 th and 13 th centuries, that we could have analyzed, have only given o





iron oxides for that vitrified brownish-black color, and it is still the iron protoxide that is employed today for that purpose.<sup>1</sup> Further, a calcined copper protoxide gives a brown powder, that placed in the oven with a flux produces an effect similar to that presented by the iron protoxide, but with a greenish tinge.

Note 1.p.376. M. Oudinot, a glass painter, on his part has had analyzed fragments of the painted glass of the 12 th and 13 th centuries; the analysis has likewise only given iron protoxide. Today this painting is obtained by means of iron scales collected in blacksmith shops, sifted to separate particles of metal and pulverized with a flux. Also formerly and now again is employed an iron mineral called red hematite, a natural iron oxide browner than red. This substance gives to grisaille a warmer tone than the iron scales from blacksmith shops.

An important question in the manufacture of the glass, besides those concerning the artist, is the mode of obtaining the sheets of glass. In the 12 th century, according to Theophilus, the sheets of glass were made by means of two processes no longer employed in our days.

With the ponty the workman gathered in the crucible a mass of incandescent glass; he blew so as to produce a bottle of elongated form. Bringing the end of this vessel near the flame in the furnace, this end melted and opened. With a piece of wood the workman dilated the opening till it equaled the largest diameter of the vessel.

Then by bringing together the opposite sides of this end, he formed a figure of eight (Fig. O). When so prepared, this glass was detached from the ponty by rubbing a piece of wet wood on the neck of the bottle. Heating the end of the ponty in the furnace with the bits of incandescent glass still on it, he attached the end of the ponty at the middle of the figure of eight. The upper end of the bottle was then presented to the flame; then the opening was enlarged as before. The piece of glass being so arranged, it was detached from the ponty and carried to the cooling oven. This glass with the form given in Fig. O was brought again to the fire to be dilated, split open and flattened.<sup>1</sup> The process of making glass in disks was also employed, more rapid and simpler. The workman blew a vessel: he presented the bottom to the flame, as stated above; then dilating that a





and he rotated the ponty very rapidly; the dilated edges of the glass by centrifugal force tended to pass out from the centre, and thus was obtained a disk with concentric striations, thicker at the centre than at the edges. The glass thus flattened by either the first or the second method was first colored in the crucible by means of metallic oxides. Theophilus does not mention flashed glass, and indeed the stained glass of the 12th and 13th centuries do not show it, excepting for red. Still may be seen pieces of a beautiful orange red from the 12th century, that are tinted in the mass,<sup>2</sup> or at least for about half their thickness. This manufacture of red must be an antique tradition.

Note 1: p. 377. See Theophilus, Book II, Chaps. 6 and 9.

Note 2: p. 377. At Venice is now made red glass of a very soft tint in the mass. This glass strongly recalls certain specimens from the 12th century.

Indeed the glass cubes composing the mosaics of the interior of the church S. Sophia of Constantinople are generally of a beautiful ward red, on which the gold leaf is applied, translucent with strata of a dark opaque tone. The translucent red strata are 0.12 or 0.16 in. thick and give a beautiful coloring, which recalls that of certain red glass of the 12th century. But after that epoch red glass was obtained by a different process. The workman had two crucibles filled with greenish-white glass in the furnace. Into one of the two were cast scrapings or particles of copper and it was stirred; the blower gathered a ball of white glass in one crucible, and at once plunged it in the second crucible holding the particles of copper in suspension. He regulated the coating on a hot stone, blew and worked it as stated above. Thus was obtained flashed glass in which at most half the thickness shows the red coloring as if spread on. If one of these pieces of glass is broken, the red color shows itself by strata irregularly scattered in that flashing on greenish-white glass, as indicated by the section (Fig. 1). This process of coloring by overlapping irregular strata gives to a red tone a veined and glittering appearance of great strength. One will indeed understand, that the light passing through the glass and striking the strata of red imbedded in the paste and both reflecting, must produce a coloring of unequalled intensity and transparency. Each stratum of red paste produces the effect





effect of a spangle, and one sees at the same time a translucent red coloring and a red gleam reflected from the neighboring strata. Later and from the middle of the 14 th century, red glass is obtained by an extremely thin flashing on a greenish white glass; the red is no longer imbedded in the paste, but laid on it in making the disk.

Thus this red glass gives a more uniform coloring, and viewed near is more powerful than that of the glass of the 12 th and 13 th centuries; but at a distance, the gleam of this flashed glass is less luminous and refined; it is often heavy and crushing in the entirety; in brief, the decorative effect is not so good. Yet the operation of flashing the disks still gives certain irregularities, stripes more or less colored, that retain a certain transparency of tone. Today the flashed red glass is perfectly uniform in tone, and if glass painters employ it and desire to obtain a fine coloring at a distance, they are obliged to vein it by artificial means. In the 12 th century, they did not have yellow obtained with silver salts; yellows were smoked white glass, produced by chance, as Theophilus indicates. <sup>1</sup>

Note 1.p.378. Book II, Chap. 7.

Yellows from silver salts only date from the 14 th century; they are only applied on white glass.

From the ornamental point of view, glass in disks or roughly extended presents an advantage. Since this glass was tinted in the mass, at least during the 12 th and 13 th centuries (excepting red), differences in the thickness of the sheet of glass caused variations of tones to appear, that the artist glaziers utilized with much skill by cutting the glass so that the thinnest portion came beside the white. Even for uniform grounds, these differences in thickness gave a gleaming appearance to all coloring, which at a distance singularly increased the intensity of the tones. All colorists know that to give a tone all the value that it should have, it is necessary to present it to the eye only in bits, by gleams, if this may be said. The Venetians and Flemings knew that law well, and to convince one of it, it suffices to observe their paintings.

What is true for a painting applied to a panel or a wall is even more rigorous for a translucent painting. In stained glass, the colors affect the light passing through it and have such a





gleam, that the smallest colored bit assumes a distance by radiation a prodigious importance. But it must be said, that the radiations of translucent colors have very different values. Thus only taking the three fundamental colors, those of the p prism, blue, yellow and red, these three colors applied to glass and therefore translucent radiate more or less. Blue is the c color that radiates most, red radiates badly, yellow not at all if it approaches orange, a little if it is straw colored.

Thus assuming a design for glass composed as in Fig. 2. The black lines indicate the leads (see A). The compartments R are red, those marked L are blue, and the strips C are white. Observe the effect produced at a distance of about 66 ft. (See B).

The circular spaces L in blue radiate to the dotted circle, and the red will only remain full in the middle of each area R. It results from this, that all surfaces O will be red tinged with blue, i.e., violet; that the isolating whites between the tones having no colored radiation, will be slightly tinged with blue at v, as well as the leads themselves; that the general effect of this stained glass will be cold and purplish on the greatest part of the surface, with red spots r, discordant if you are not very far from the glass, dark if you are far distant from it. But if (see A) we diminish the areas of the blue disks by black painting as shown at D, we partly neutralize the radiating effect of these disks. If instead of the white strips C we place strips of yellowish or greenish white, and if we trace lines or pearls on these strips as marked at f, we then obtain a much better effect. The blues being thus strongly enclosed by black lines outside and inside, lose their radiating power. The reds are much less violet in their vicinity. The yellowish or greenish white tones of the strips acquire delicacy by the bluish tinge affecting their ends, but leaving between those ends a warm portion allied to the red, especially if we have taken care to increase the value of the leads by these round spots or by simple inside lines.

On the contrary, let us assume the squares R (see A) to be blue and the disks L red. At a distance the strong radiation of those large blue surfaces in comparison to the red spots will be such, that these red spots will appear black or dark violet, and that one cannot suspect the presence of red. The white strips will appear a dirty gray, or green if they are yellow, or





bluish green if they are greenish white. The effect will be bad and without contrasts. The radiation of the blue will weaken and dirty the other tones, and these will no longer have the power to give the blue its delicacy and transparency. The general coloring will be cold, tinged with lake and of a false tonality; for in stained glass even more than in painting, each tone acquires value only by the contrast of another tone. A light blue near a yellowish green becomes turquoise; the same blue near a red becomes bluer. A red near a straw yellow has an orange tint, while it will be tinged violet near blue.

These elementary principles and others, that we shall have occasion to develop, were employed in practice by the glass painters of the 12 th century with a certainty and experience, such that it is indeed necessary to admit for those artists a long series of observations. We do not think that they have established a written theory of those relations of the translucent colors, a sort of scientific treatise, as one might do in our time; they proceeded by the experimental method, and the traditions acquired were perpetuated in the atelier.

As for the style of drawing applicable to painting on glass and as for harmony of the simultaneous effect of translucent colors, the 12 th century has an incontestable superiority over the 13 th. Then in the 12 th century, the design proceeds after the Greco-Byzantine method; the nude imposes the form, the clothing only encloses it, nothing is left to chance; the entirety and the details are conceived and executed according to principles based on profound observation; while only later one often finds in the midst of beautiful works negligence and forgetfulness of those principles.

The glass employed by the artists of the 12 th century may be classified thus:--

- |          |                                                 |
|----------|-------------------------------------------------|
|          | 1. Clear blue, slightly tinged with turquoise.  |
|          | 2. Sapphire blue, but greenish.                 |
| Blues.   | 3. Indigo blue, intense.                        |
|          | 4. Azure blue, very light, linen gray.          |
|          | 1. Straw yellow, smoky.                         |
| Yellows. | 2. Saffron yellow or bistre.                    |
|          | 1. Red not flashed, very soft and uniform tone. |
| Reds.    | 2. Intense red, striated.                       |
|          | 3. Light red, smoky.                            |





1. Yellowish green, clear.
  2. Emerald green. This tone in the hand seems to approach gray rather than green; it assumes its brilliancy at a distance, especially by contrast of blue and red tones.
  3. Bottle green. In the hand, this green appears cold; it assumes its quality like the last.
- Greens.
1. Light purple, warm.
  2. Clear purple, bluish.
  3. Dark purple, like wine.
  4. Very light purple, smoky for flesh.
- Purples.
1. Reddish brown, color of Spanish wine.
  2. Dark green, warm.
- Rare tones.
1. Yellowish white, smoky.
  2. Grayish white, bluish.
  3. Pearly white. <sup>1</sup>
- Whites.

Note 1.p.381. The blue glass of the 12 th century possesses a particular quality that causes it to be recognized among all those of other epochs; this is that it appears blue in the light of a lamp, while those of later epochs pass into a laky gray, green or violet. This observation was suggested to us by glass painters, skilful practitioners, and experience has confirmed it.

All these chemical operations of the glass painters of the middle ages being empirical, the account of the unexpected and of variations was long. Theophilus allows us to understand that chance alone gave certain tones, by which the artist knew how to profit. The palette of the glass painter was then very extensive, and it is necessary to take the classification here given as not absolute. We have only indicated the values; but as for tonality, these values present numerous varieties. The talent of the glass painters particularly consisted in never placing two equal colors beside each other, and in profiting by the varied tones with the real feeling of a colorist.

We have already stated, that all these tones excepting red, are mixed in the mass of the glass and not flashed, as they were made later.

This palette being composed, the glass painters proceeded as indicated by the monk Theophilus. They traced on a cartoon the principal lines of the figures and ornaments; or rather the leads were only the accurate design of all parts. In composing





his cartoon, the artist thought of the setting in leads; that is clearly evident by the careful examination of the stained glass of the 12 th century, since the outlines are always accented by leads, which then form the general drawing. On these cartoons, did the artists paint all the shadows, half tints and internal lines? We do not believe this for two reasons; the first being that it sometimes occurs that pieces of glass have only been cut, and that by lack of time or forgetfulness, they have not been finished by painting; the second is that sometimes the same cartoon has also served for two figures, for example as pendants, when the internal modeling differs in the two figures. There is every reason for admitting that the master traced the outline on the cartoon with some internal chief lines; that the workmen cut the glass on this cartoon, tracing the principal lines as joinings, and that the glass was temporarily assembled on the frame in light from below, and was painted by inspiration without recourse to an opaque cartoon modeled in advance.

Fig. 3<sup>1</sup> will illustrate this mode of procedure. At A we have drawn the cartoon prepared by the master; at B is the modeling on the same glass, when it has been cut and temporarily assembled on the frame before upward light. It is conceivable that with such an accurate drawing showing the leads, it was scarcely necessary to indicate on the cartoon all the modeling. The dotted lines on Fig. A give the joining leads, that cross the contours. To avoid too large pieces of glass, the master has drawn the band a on the mantle, which is of a different color, and that the leads frankly outline.

Note 1.p.382. From a stained glass window of the cathedral of Mons, beginning of 12 th century, representing the Ascension.

It was necessary that the painters entrusted with placing of the grisaille or the modeling on the pieces of glass, cut according to the cartoon, could draw. It is true that then in the West as in the Byzantine schools, there were actual procedures for painting a head or a vestment;<sup>2</sup> and those procedures were really based on long and profound observation of the decorative effects. Thus when the master had drawn the cartoon (and the style belonged to him), it sufficed to find skilful workmen sufficiently imbued with the traditional procedures to paint in the cut glass the proper modeling. We do not understand the art of painting in that manner today, and it is unnecessary to regret





this, if it concerns paintings to be placed outside in a general ornamental effect, like objects possessing their special qualities independent of an entirety. But if the painting participates in an entirety, if it enters into the general harmony, that every edifice should present to the eyes, it is necessarily subject to purely physical laws, that one cannot disregard, and which are superior of talent or the genius of the artist. Indeed the genius of a master cannot modify the laws of light, of perspective or of optics. We know well that a very great number of artists of our time are endowed with a temperament too spirited or independent to submit to any laws not dictated by their caprice; but we know with no less certainty, that light, optics and perspective have not yet changed the laws governing them to suit those unruly minds. If light, optics and perspective are physical combinations of a different age, if they reigned in barbaric times, they still reign at all times, and they do not yet appear disposed to abdicate, nor even to grow old. Now on the contrary, the artists that composed the stained glass windows of the 12<sup>th</sup> and 13<sup>th</sup> centuries manifested their absolute submission to those laws, and applied them with as much intelligence as modesty. That submission gives us an instruction by which we rarely profit, but still is no less good and worth the trouble of examination.

Note 2.p.382. See Manuel d'Iconographie Chretienne, Grecque et Latine, with an introduction by M. Didron, translated from the Byzantine manuscript by Dr. Paul Durand. Paris. 1845.

No one is ignorant of the attempts made for thirty years to give to painting on glass new brilliancy. Our most skilful glass painters have sometimes made excellent imitations: they have completed ancient stained glass with perfect imitation, such that one cannot distinguish the restoration from the old parts. Thus they have acquired ample knowledge of the procedures, not only of the material manufacture, but of art applied to this kind of paintings.<sup>1</sup> They have been able to recognize the remarkable qualities of the ancient stained glass in decorative effect and harmony, and the perfection of certain processes in execution, attained with difficulty, of material skill of the workmen, and to appreciate the style of the masters, so very appropriate to the object. This art of the glass painter is therefore not a mystery nor a lost secret.





Note 1.p.384. There may be cited as remarkable among those of facsimiles : the panels of the restorations in S. Chapelle, due to MM. Lussan and Steinheil; those of the windows of the 12 th century in the abbey of S. Denis, due to M. Gerente; the restorations of the stained glass of Bourges and of Mons made by M. Goffetter.

What has been forgotten for several centuries is the only true means appropriate for painting on glass, a means indicated by observation of the effects of light and of optics; means perfectly understood and applied by the glass painters of the 12 th and 13 th centuries, neglected from the 15 th and disdained since, as we have already stated, in spite of those unchangeable laws imposed by light and by optics. To desire to reproduce what is called a picture, i.e., a painting in which one seeks to render the effects of linear perspective and of aerial perspective, of light and shadow with all their transitions, on a panel of translucent glass, is an undertaking as rash as to pretend to render the effects of human voices with stringed instruments. A different procedure, other conditions, another branch of art. There is almost as great a difference from the picture, opaque painting, seeking to produce the illusion, and painting on glass, as between the same opaque picture and a relief. The relief may be painted, yet it can never produce the effect of an opaque picture on a wall or a canvas; this illuminated relief will only be an assemblage of figures on a single plane. In an opaque picture, a painting, the radiation of colors is absolutely subject to the painter, who by half tints, shadows varying in intensity and value according to the planes, can diminish or increase it at his will. The radiation of translucent colors in stained glass cannot be modified by the artist; all his talent consists in profiting by it according to a harmonic principle in a single plane, like a rug, but not according to an effect of aerial perspective. Whatever one does, stained glass never represents and cannot represent more than a plane surface, it even has its real qualities only on that condition; every attempt made to present several planes to the eye destroys the harmony of color without producing the illusion in the observer; while an opaque painting has and must have the effect of causing the eye to penetrate into a series of planes, of presenting a succession of solids. If there be but one figure in a painting and that figure be placed on a solid





background, the painter assumes to give the figure the appearance of a body with thickness. If the painter does not attain this result in his first attempts, it is no less certain that this is the aim to which he tends, just as much in Greek antiquity as in modern times. To transpose this quality of opaque painting into the art of translucent painting is then a false idea. Translucent painting can only propose as its aim, that the design may be based as strongly as possible on a harmony of colors, and the result be satisfactory as such. To desire to introduce qualities suited to opaque painting into translucent painting is to lose the precious qualities of translucent painting without possible compensation. This is not here a question of routine or of blind love for an art, that one desires to maintain in its archaism, as sometimes pretended; it is one of those absolute questions, because (we cannot repeat too frequently) they are solved by physical laws, in which we can change nothing. You can never sing to a guitar like Rubini, and if some persons take pleasure in hearing the overture of William Tell played on the flageolet, that would not be to the taste of musical amateurs.

We believe this discussion to be in place here, because we have heard many times repeated:- "What if the stained glass of the 12 th and 13 th centuries is beautiful, this is no reason for reproducing eternally the best types that they have left us; it is necessary to take into account the progress made in the domain of the arts; those archaic figures are no longer to our taste, etc." certainly it is not at all necessary to copy forever those types of the fine epoch of painting on glass, in brief making imitations; but what should not be lost from view are the procedures of art, so skilfully applied then to painting; what is necessary to avoid (because it is not an advance but indeed a decadence) is that transposition of one form of art into another opposed to it. With more persistence than good faith, men often affect to rank us among the fanatics of the past, because we say:- "Profit by what is done; do better if you can, but do not ignore the route already traversed, the results already obtained in the domain of the arts. Now what you frequently give us as an inspiration full of promise, is only a forgetting of long and useful labors, an incoherent assemblage of badly understood forms, or procedures





wrongly applied."

The stained glass of the 12 th century, like that of the 13 th, is held in place by leads, that enclose each piece of glass and form the panels; strips or points keep these panels in their places, and prevent them from bending under their own weight. These panels are set in iron frames (see Art. Armature).

It is clear that these panels cannot exceed certain dimensions, since they must resist the pressure of the wind. The setting in leads leaves an elasticity very necessary for the preservation of these panels. The glazier must take into account these material elements of the work. These conditions are no less imperative than those imposed by light and optics. They are conditions of stability, of durability, and which thereby must influence the conception of the artist and be utilized by him, if he is skilful. The iron frames outline the great ornamental divisions and give the scale of the object, a matter more useful than generally thought. The leads accent the design and separate the colors by a strong line, a condition necessary for the harmonious effect of the translucent tones. There remains the internal modeling. That is where the glass painters of the 12 th century in particular have shown their profound observation of the effects of translucent painting. Those artists knew:-- 1, that the tones have only a relative value; 2, that the radiation (halation) of certain translucent colors is such, that it changes or modifies even the quality of those colors; 3, that the modeling applied on the glass in even the darkest parts must allow the local tone to appear, not through a glazing but in pure spots; for a shadow covering a colored glass gives at a distance an opaque tone, that does not participate in the color of the glass it covers, but in the radiation of the adjacent colors, by reason of the radiating effect of those colors. Thus to make our explanation clear; assume (Fig. 4 7) a disk A of red glass surrounded by blue glass; if we have placed a shadow around this disk (itself translucent like a slightly opaque glaze), this shadow will participate, not in the local red tone of the glass, but in the blue radiation of the surrounding glass. This shadow will therefore take a false and dirty tone, a mixture of brown and blue, that will cause the blue to appear hollow and without solidity, and the red tone discordant. On the contrary (Fig. 4 B), if we have





taken care to place that shadow on the disk, not flat but hatched and leaving a red ring all around it, this ring and the intervals left in the hatching will give a red ground to the shading, and the blue will retain its quality. The ring and the intervals of the hatching will assume sufficient value because of the contrast of the black lines, to contest the radiation of the blue tone and to leave to the shading of the disk its red ground.

Let us see the application of this formula. Here (Fig. 5) is a fragment of the beautiful stained glass of the cathedral of Chartres,<sup>1</sup> which represents the tree of Jesse. This glass dates from the middle of the 12<sup>th</sup> century.<sup>2</sup> The ground is blue, that clear blue slightly tinged with green, that belongs to the manufactures of that epoch, and that recalls the color of certain autumn skies, between the orange band of the setting sun and the purple near the zenith. The robe of the king is of a vinous red, a warm purple; the mantle emerald green, the pallium and crown are smoky yellow, the shoes and the surfaces of the sleeves are red. It is evident that the modeling painted on these vestments is only composed of a series of hatchings, allowing the local tone to pass between them, particularly near the borders; so that the radiation of the blue glass ground is neutralized by these spots of the local tones of the vestments passing through the crevices of the hatching. These observations seem to partly contradict the demonstration accompanying Fig. 2, but are merely a corollary of it. In Fig. 2 we have seen that to neutralize the effect of the radiation of the blue tones on the red tones, we have diminished the area of these blue tones by opaque painting, a sort of perforated screen, that subjects their contour to indented forms. Now at a distance, when the translucent colors are very radiating, that property of these colors is much reduced by the aid of the perforated screens; but by the effect of that radiating property, the perforated screens appear diffused, and the crevices left pure simply lose their relative coloring value. The contrary effect is produced for colors with feeble radiation, their color intensity increasing by reason of the small surface left pure in the crevices of a screen. For example (Fig. 6 7), take a blue glass A, whose radiating surface has been diminished by the opaque painting or screen B. At a distance this blue will





produce the effect indicated at C. The farther it is distant, the screen painting is the more confused, but also the blue will tend more to gray. Let a red glass be painted in the same manner; the more distant it is, the more the screen painting appears enlarged by losing a little of its opaque quality; if at a great distance, the red will only be seen in narrow lines as represented at E; but these lines will gain in intensity of color what they lose in extent. We admit that the red glass is streaked; if it were uniform, it would appear at a distance like wine or chestnut. According to this principle, each translucent color must then receive the screen painting according to its radiating property. The glass painters of the 12 th century prove by the works they have left us, that they had a perfect knowledge of these laws, and we confess for ourselves, that we know these only by careful study of those works. Whether they arrived at these results by prolonged empiricism or by wise observations collected in the Orient, that is really of very little importance to us; the fact is a reason for their methods. For all stained glass known, that of the 12 th century alone possesses this clear and assured harmony, that one cannot weary of admiring; such a frank harmony, that at a great distance and without needing to examine the style of the designs, one of those stained glass works is recognized in the midst of many others.<sup>1</sup> Knowing then the more or less radiating properties of colored glass, the glass painters of the 12 th century have placed and painted this stained glass in accordance with these properties, and also with the influence these translucent colors exert on each other.

Note 1.p.387. Western facade. This drawing is 1 : 6.

Note 2.p.387. See Art. gothédrale.

Note 1.p.390. Among others, see the western stained glass windows of Notre Dame of Chartres; those of the abbey church S. Denis, executed under abbot Suger; some stained glass windows of Mans, Vendôme and Angers.

For example, knowing that the clear blue recently mentioned possesses a radiating quality above all other colors, they employed it in large areas only in grounds; and to prevent the radiation of those blue surfaces from injuriously affecting the adjacent tones (all radiating less in different degrees), they have charged these with lines, hatchings, opaque details like





screens, so as to give these tones a greater intensity by virtue of the law explained in Fig. 6; but further (always by virtue of this law and that also explained in Fig. 4), they carefully avoided making these tones dirty by solid shadows, even if translucent, and they have always allowed spots of the local tone to pierce through the network of the heaviest shadows. These artists have also used pearly white glass as an indispensable aid for giving the colors their relative proportions. Thus in the example given (Fig. 5), the branches of the tree of Jesse, some leaves of the bouquets, are cut from white glass; but these luminous parts are charged with painted details, that lessen the brilliancy and the hardness. <sup>2</sup>

Note 2.p.390. For the general coloring of this stained glass, see *Monographie de Notre Dame de Chartres*, by M. J.B. Lassus. This stained glass is very faithfully copied by M. P. Durand. The accuracy of the drawing and of the modeling could not be more complete, but the coloring given by chromolithography cannot render the effect of the relations of translucent colors. Thus the blues are heavy and dark, the greens hard, etc.

The blue ground surrounding the tree, the principal subject, and which occupies the entire middle of the window, is opposed by two wide borders, whose arrangement is given here (Fig. 7); for it is by the entirety as much as by the details, that this composition is commended. At A prevails the blue ground from which is vigorously detached the tones of the personages and in light the branches of the tree. At B are the prophets on a red ground. Those prophets are chiefly clothed in blue and smoky yellow, and they hold white scrolls. This warm tonality (for the blue here is no longer the same as that of the ground, but more intense or more green) gives a luminous transparency to the blue ground of the centre. To connect these red grounds of the prophets, the artist has draped in a red mantle the Jesse lying at C; he reposes on a bed hung with white, that serves as a point of departure, a base for the tonality of the tree. A dark blue robe that covers the upper part of the body of Jesse, this white and some yellow fringes, give incomparable brilliancy to the red of the mantle. The red semicircles serving as background for the prophets are enclosed by a blue band in the tone of the ground A, and by a white border charged with details; then the spandrels G are on a ground of beautiful emerald





green, warm and clear. Around is developed a border, splendid in composition and brilliancy, that he give in detail at one-sixth full size (Fig. 8). At A are the red grounds of the prophets; at B is the blue band that recalls the tone of the ground of the Jesse, then the wavy white stripe scratched in with a poin on a bistre tone applied on the glass; at C is the green ground of the spandrels. These are charged with a blue square painted with bistre, extremely delicate details being scratched in with a point, according to the method indicated bn Theophilus. These blue squares are intersected by ornaments of warm purple, that are vivid on the green ground. A white border, also covered with bistre and scratched, encloses the blue square. The red appears anew at R. A beaded yellow forms the inne line of the border: it is doubled by a blue strip F of the same tone as the ground of the Jesse. Red reappears at G, and the blue of the ground of the Jesse at L. For the interlacing beaded bands, this is done on white glass. The circles and lance leaves are smoky yellow; the leaves are green and purple; the outer beaded strip is a doubtful yellow. In this stained glass, there are only these tones of glass.

1. pearly white; smoky white.
2. Clear blue.
3. Intense greenish blue, and exceptionally indigo.
4. Emerald green.
5. Green approaching a turquoise tone.
6. Warm purple.
7. Red.
8. Yellow; two tones.
9. Flesh tones are light and smoky purples.

According to what Theophilus said, it was easy for the master to indicate colors on his cartoon by letters, and to establish harmonious relations with more certainty, than he could have done in experimenting with a palette of tones. The blue tone of the principal subject dominated the entire tonality if the rest. It was necessary to allow the luminous splendor to gleam in this centre. This principle determined the red grounds of the prophets, the recall of the blue of the principal ground in the semicircular bands. To give value, both to the vigor of the red coloring and to the radiating transparency of the blue, emerald green grounds were placed in the spandrels. Then the blue ground





was recalled , but giving it a solid value by adding that delicate ornamentation of the squares. Finally, the border summarizes all the tones scattered in the principal subjects, but in small pieces; so that this border with a solid and strong effect still does not rival the broad arrangement of the central parts. These white beaded interlacings are a brilliant border for the principal paintings; a border connected to the subjects by the blue squares delicately lined and enclosed by white strips.

If we now examine the details of this border (Fig. 8), we observe that the purple, green and yellow leaves, detached from the blue ground L, are modeled according to the method indicated by Fig. 4, i.e., that this modeling always allows to be seen pure spots of glass between the hatchings, and notably on the borders of the ornament, so as to oppose the radiation of the blue ground, that further is visible only in pieces relatively small.

It is too easily believed that the old paintings on glass partly owed their harmony to the stains deposited by time on their surfaces; we have frequently heard glass painters even pretend, that this stained glass of the 12 th and 13 th centuries must have produced a discordant effect when new. This opinion might be sustained in regard to certain trade stained glass, such as made in all ages, and especially in the 13 th century; it appears to us erroneous to apply it to the glass of the 12 th century, that we unfortunately still possess in too little quantity, and to the good glass of the 13 th. Examining Figs. 3, 5 and 8, it is easy to see that the painters perfectly avoided discordant effects by the multiplicity and the arrangement of lines or hatchings composing the modeling. By leaving the grounds clear, and selecting for these grounds frank tones, but of a beautiful coloring quality and luminous, they took care to place on all the tones forming the composition, figures and ornaments by a close modeling or delicate details, that give to these tones the proper relative values. Men customarily replace now this delicate work, so well arranged to make avail the quality of each tone, by an artificial staining applied to as to allow to appear spots of pure tone, and thus sometimes harmony is cheaply obtained. But it must be confessed, that this procedure is barbarous, and permits the





supposition that our glass painters have no very clear theory of the conditions of the harmony of stained glass. This is nearly as if to conceal the discord between instrumentalists executing a symphony, a continuous bass is made to dominate from beginning to end, a sort of neutral roaring with some rare intervals allowing the hearing of one or two bars without this monotone a companion. To execute a painting, particularly if translucent, i.e., of unrivaled brilliancy, to stain it under pretext of harmonizing it, is an idea that might enter the heads of amateurs, passionately fond of the patina of art objects rather than of those objects themselves, but unable to come to the artist mind, that seeks by all sincere and profoundly studied means to render its conceptions. It is always evident that already in the 13 th century, men placed certain glazes on parts of the common glass; <sup>1</sup> but these light glazes applied cold, and probably to the glass set in place, were expedients for obtaining a general effect, and not a staining placed by chance on the panel.

Note 1.p.394. We have recognized the existence of these artificial stainings on stained glass enclosed in plaster of paris soon after their execution.

The stained glass from the 12 th century in the cathedrals of Chartres and of Mans, the abbey church of S. Denis, of Vendome and of Angers, could and may dispense with that patina, since (excepting the grounds, that we should not forget are made of glass of a quality incomparably harmonious) all the details of ornamentation and the figures are covered with the work of the brush. Thus for artistic glass painters, two distinct operations were proper for obtaining the general harmony of stained glass, when the cartoon was drawn: 1, the marking of the tones of the glass on this cartoon; 2, the work of the brush on this glass, which completed the harmony by giving each tone the proper relative importance.

The method adopted by the artists of the 12 th century for the first part of this work is given by Theophilus; it was by means of letters that the master indicated the colors on the cartoon.

Now this method must approximate that which we are to indicate, based on examples of stained glass of that epoch. Assuming the five vowels to signify:--





A = white.

E = dark purple.

I = light purple.                      Compound colors.

O = emerald green.

U = bluish green turquoise.

The consonants signify:-

B = blue.

J = yellow.                      Simple colors. 1

R = red.

Note 1.p.395. The glass painters employed several values of each tone, as we have indicated above. It was easy to distinguish each value by a sign; thus the B (blue) could be B 1, B 2 or B 3, so indicating clear, light, turquoise blue, the sapphire blue, indigo blue, etc.

We start from this primary law; that every simple color dominating in a subject, for example forming the ground, it is necessary to employ with it a majority of compound colors; that if with this simple color of the ground other simple colors are used, it is necessary, either that these colors be in small pieces, or be isolated by an important addition of white. Example; in Fig. 5 of the tree of Jesse of Chartres (first king) the ground being B, the vowels must dominate in the composition. Indeed the artist has used; mantle, O; robe, I; branches, A; flowers, E, U, I, O. The consonants appear only in small parts: crown, pallium, two lower leaves in the upper bouquets, central leaf in the lower bouquets, J; clasp, ruffles and shoes of the king, R. If we take the other kings above the first and the Virgin at the top, the law is the same, i.e., the ground being the consonant B, the vowels compose the figures and ornaments. At the bottom, Jesse is covered by an ample red mantle, for a reason in harmony indicated above, but this mantle is entirely surrounded by the letter A, i.e., by white. The same rule for the border; the ground of the bouquets is B, the bouquets are I, O; the central lancet and the round are J; but the central lancet is very thin and is connected with white, like the round. Yet the grounds of the prophets are R, and B enters strongly into the vestments of these prophets, as well as J; but this is one of those procedures in harmony common in that epoch, and which confirm the rule given above. First B or blue is employed in most of the vestments, either greenish or an aquare light





blue, which is no longer a simple color; J is either straw or very smoky. There is here a special case, the harmonic principle of the artist was this; to obtain<sup>a</sup> brilliant centre, clear and light, soft to the eye. To attain this result, it was essential to have around this central portion a vigorous coloring, even a little hard, a sort of repelling dissonance. Hence these combinations of red and blue. But if one examines this beautiful stained glass, with what art of the colorist is this effect obtained! In those blue vestments of the prophets run purple bands; then on the adjacent parts are azure blue and very luminous tones of emerald green; long white scrolls and even white robes destroy what would have been too forced in the tones of these two borders of the prophets. The strength of the ground of emerald green in the spandrels, separated from the red ground of the prophets by a strip of white and a strip of pure B, that is the B of the ground of the kings, adds also to the solid effect of the tonality, and this emerald green is made refined and soft by the wide purple leaves, that intersect it, and which come from the lined blue squares (Fig. 8).

The glass painters of the 12 th century sometimes employed green grounds, but only for accessory parts, ornaments, and to cause these grounds to participate in a system of borders in the style of that just described. Further for the subjects during the 12 th and 13 th centuries blue and red grounds are alone employed, i.e., simple and strong colors, and this is understood. From the instant, when the glass painters recognized that with a dominant color as a ground, there were no longer but exceptionally required colors of the same order, i.e., that with a consonant dominant color (to return to our theory), it was only necessary to use vowel colors, and vice versa, being forced to take for grounds the simple colors; for assuming that one had taken as ground a purple color (a compound color), for example, the objects in that ground could only be blue, red and yellow (simple colors). That diminished the resources of the palette of the glass painter to three colors and white for all vestments, nudes and ornaments of the subject, which presented a monotonous and restricted harmony. In adopting blue and red grounds, particularly blue, the glass painter had for coloring the subjects and ornaments, two greens, two purples, linen gray blue and turquoise blue, i.e., six colors, without counting wh-





white and the broken whites. Besides, with the blue ground and by means of the same artifices, he could still employ red and yellow, and with the red ground, blue and yellow. There is again another consideration; blue and red alone as ground tones may pass without painting, without appearing hollow. Yellow is too absorbent, not by its radiation, since it has none, but by its brightness; as for mixed and broken tones, if they are not charged with painting, i.e., modeled, they do not sustain themselves; the eye, so to speak, passes through and seeks something beyond them. Blue and translucent red alone without painting or modeling, present to the eye a solid and intense colored surface, at which it stops.

We have seen (Figs. 2 and 6), that the painters reduce the radiation of the blue by placing on the blue a screen painting, that diminishes the area, and changes its tonality for the benefit of adjacent less radiating colors. But as for the grounds of subjects in the 12 th and 13 th centuries, it was very rare for blue grounds to be charged with a screen painting; thus to oppose the radiation of these blue grounds, the glass painters took care to place many strips, white details or very light greenish blue, in the subjects placed on those grounds. Indeed light grayish blue, which has a radiation equal to sapphire blue, retains all its value beside this sapphire blue; it is the same or nearly so for certain pale purples and lilacs, and certain glaucous greens. Thus these tones are very frequently employed in the subjects or ornaments detached from a frankly blue ground. To prevent the blue grounds from radiating beyond their perimeter, the artists of the 12 th and 13 th centuries employed a means, that never failed in its effect. They placed around this ground a red strip and then a white strip. Here is the result produced then; the presence of the white strip prevents the red from becoming violet by the radiation of the blue. Take a subject A on a blue ground (Fig. 9): if this blue ground is enclosed by a red strip B, and that by a white strip C, the radiation of the blue has no effect on the red strip and does not make it violet; this red retains its purity and much enhances the delicacy of the blue tone. The effect of the white strip will be still better if this strip is pearled as indicated at P, because the white being reduced to repeated touches assumes more firmness. But if one does the contrary, i.e., places





the white strip at B inside and the red strip at C outside, the white will be slightly blued by the vicinity of the blue, and it will no longer present for the red a contrast to accent its brightness; therefore the red will be tarnished by the radiation of the blue passing across the white.

By an experiment easily made by every one, it is easy to take this effect into account. If the red strip be placed between two white strips (especially if pearled), it retains its value and one obtains a harmony of extreme delicacy; for then between the red, that loses nothing of its quality, and the blue is interposed a pearled strip, that forms a most happy transition between the red and the blue. Indeed, the placing of red and blue is dangerous, it is a real discord, and it was employed with much skill by the glass painters of the 12<sup>th</sup> and 13<sup>th</sup> centuries. If by the outer position of white the red retains its quality and is no longer subject to radiation from the blue, the harmony is hard; if the white is wanting, the red is tinged with violet and assumes a false quality; the interposition of a greenish or yellowish white between the red and the blue (on a condition of having white also outside of red) produces the most happy effect. The painters that executed the beautiful glass windows of Chartres, Bourges, etc., frequently employed this means of setting blue grounds.

After having studied our most beautiful French stained glass, it can be established that from the point of view of harmony of tones, the first condition for an artist glass painter is to know how to regulate the blue. Blue is the light in the glass, and the light has value only by contrasts. But it is likewise this luminous color, which gives a value to all tones. Compose stained glass into which blue does not enter, and you will only have a dull or crude surface, that the eye will seek to avoid; scatter some blue touches in the midst of all these tones, and you will at once have piquant effects, if not a wisely conceived harmony. Thus the composition with blue glass strongly occupied the glass painters of the 12<sup>th</sup> and 13<sup>th</sup> centuries. If there be only one red, two yellows, two or three purples and two or three greens at most, there are infinite hues of blue, from the light linen gray blue to the dark violet blue, and from the glaucous and turquoise blue to the slightly greenish sapphire blue; near these blues are placed with a very refined observa-





observation of the effects that they should produce on the other tones, and that the other tones should produce on them. For example, very happy harmonies are produced with glaucous blue tones and reds (the red as a ground, it is well understood), with the same blues and indigo blues, and with emerald greens. The association of the green and blue, so dangerous, gives to these artist colorists tonalities of extraordinary refinement, examples of which can be found only in certain Persian enamels and in the flowers of our fields. Everyone has cast his eyes on the soft harmony of the flax flower on the green. But just as nature has always placed greens suited to each coloring of the flower, these artists have done similarly, perhaps inspired by those models. Always in the great glass windows or those with legendary subjects in the 12<sup>th</sup> and 13<sup>th</sup> centuries, the eye is never shocked by those blemishes, that appear in the stained glass of later epochs. The harmony is never deranged by a touch badly placed; all is connected and joined together, as in the beautiful rugs of the Orient.

Evidently for each composition, each stained glass window, a tonality is adopted by the composer; one can almost say that there are stained glass works in a minor or major tone. That is apparent in edifices in which exists a great number of these glass windows, like the cathedrals of Sens, Bourges, Mans, Chartres, Tours, Troyes and Auxerre.

Still this old glass never assumes russet colors, covered by an amber glaze sometimes given to certain glass of the 16<sup>th</sup> century, that our modern glass painters take as a warm coloring, but which has the great inconvenience of lacking light, and of giving a false tone to interiors, without air and without depth; so much so that in an interior affected by this coloring like that of a lamp, it appears as if one chokes, and as if all objects approach the eye.

Partly to the judicious use of blue in their glass, the artists of the 12<sup>th</sup> and 13<sup>th</sup> centuries owe the giving to glazed interiors a depth and a pearly atmosphere, which makes them appear higher and longer than they actually are. Blue is then the base of the coloring of the glass; but it is likewise a danger into which the artists of the 13<sup>th</sup> century have sometimes fallen by giving some of their glass a disagreeable violet tonality, or an excessively cold tonality, that affects the sense





of sight just as an acid affects the palate. <sup>1</sup>

Note 1.p.399. Among these glass windows of a tonality tinged with violet, we will cite one of those of S. Chapelle of Paris, (south side of the sanctuary), and among those of an excessively cold tonality, the north rose window of Notre Dame of Paris.

In the glass windows of the 12 th century, the borders assume much importance, as may be recognized by the example just given (Figs. 7, 8); as for the grounds between the subjects, they are reduced as much as possible, and are composed of ornaments rather than spots or small squares, as practised in the 13 th century. At that epoch when legendary glass was very common, i.e., composed of small subjects comprised in the same window and placed on a sort of uniform tapestry pattern, they assumed to give to this tapestry pattern, on which they placed the panels with subjects, a tone that could not rival the colors composing those subjects. For these legendary subjects, red was scarcely suitable. Its intensity absorbed the details distributed in these subjects: it made the use of purples very difficult, if not impossible, and allied itself badly with yellow: so that to color on red grounds the clothing of persons, the painters were reduced to tints of blue, to certain greens and white. They therefore adopted with very rare exceptions blue grounds for the legendary subjects, which permitted the use of all the mixed tones, and every yellow and red, when placed with skill. As for the tapestry pattern on which the subjects were placed, it was then necessary to find a coloring relatively neutral, which would allow the medallions to gleam. Desiring to attain that effect, the coloring could only seek a relatively dull tonality, but at the same time velvety and full. Red and blue were the colors which best fulfilled the purpose by their mixture, but by avoiding tones tinged with violet, which destroy all harmony. Here are then some of these grounds from the beginning of the 12 th century, chosen from those most successful (Fig. 10).<sup>1</sup> The first at A, presents an equal alternation of red and blue glass, i.e., the squares r are red and the squares b are blue. The glass painter has left in contact the pure reds and pure blues, separated only by the leads: thus he has obtained a radiation of the blue on the red and a violet tinge, but he has painted at the middle of each square a screen ornament with black strong enough to stop this radiation, so that the red t





touches seen in the interior of the screens remain very frankly red, and the radiation of the blue is lessened. At a distance the violet tinge of the borders is made neutral and dull by the vivid brightness of the red glass reduced by the painted screens, and by the freshness of the blue tones likewise reduced. Thus the general effect is this; a neutral tone, purplish, tending to blue and to red, on which sparkle the very pure red and blue touches. Since this neutral purplish tone is only the product of the two colors placed beside each other with the pure brilliancy found at certain points, there results a general tone, harmonious and velvety (although a little dark) with a good effect. The second example at B presents blue squares separated by red bands. The reds are left pure, while the blue squares are covered by a gray screen, that much reduces their radiation. Due to this painting, the blue itself takes a dull tone, and the red bands alone retain a brightness somewhat purplish at the edges by the vicinity of the blue strips left along the leads. The border of the first example A is composed of flowers blue at the top and alternately white or yellow below, detached from a red ground. Note that the red is pure, and that the blue, white or yellow are covered by ornaments. The strips a are white and b are blue. The border of the second example p presents alternating white and yellow lozenges separated by blue disks on a red ground; the strips are the same as above. By the presence of white and yellow, the red in the borders is entirely relieved from the radiation of the blue, which is also reduced by the painted screen. These borders thus assume a very vivid brilliancy, that further dulls the grounds and relegates them to the second plane of the general harmony.

Note 1.p.400. From the legendary glass windows of the apsidal chapel of Notre Dame of Semur.

Let us also present two other examples of these grounds (Fig. 11), in which white and yellow occur. In the first example A the painted scales are blue, their beginning is yellow and their enclosure is red; the red is restricted only by a simple line. As for the blue, the gray screen lessens its radiation, yet not enough to prevent a purple tinge for the red. But the straw yellow touches near the junctions of the red borders restore to them their brilliancy near these joinings. The effect is singularly harmonious and warm.





In the second example B the scales are likewise blue, the enclosures red, and the little fboriated disks are greenish white; the blues are always painted, and there are white spots with this painting, tha leisen the radiation of the blue.

One will note that the principles of coloring given above are followed with perfect tact in these grounds. The gray painting on the blues always leaves an edge of pure blue near the leads, so as to profit by sufficient radiation to soften the edge of the red. But so that this red at a distance may not appear too purplish by the blue, either the red is occupied by a black design, as in example A (Fig. 10) or the white and the straw yellow oppose the radiation of the blue as in Fig. 11.

But if in the composition of glars windows, as in all branches of the architecture of the middle ages, there are principles from which the artists never wander, when it comes to applying these principles, they make proof of great liberty and an unusual fertility. These grounds between legendary subjects, these tapestry patterns, are not composed alone of these spots, small squares and scales, but also of scrolls and interlacings, arranged in design and color so as to allow the subjects to be clearly detached. Here (Fig. 12) is an example of these kinds of grounds.<sup>1</sup> The blue serves as a ground for the subjects, red for the tapestry, the medallions A are yellow softened by gray hatching, surrounded by a pearled white strip likewise reduced by gray lines. As for the scrolls, they are composed of greenish white glass, blue (ashy blue), greenish blue, with bluish white, yellow, intense blue and emerald green, the three last tints in small quantity. These blues of different tones radiate sufficiently in spite of the painting covering them, to make the red a little violet at the edges, which gives to this tapestry the velvety brightness necessary, while remaining brilliant. The subjects are surrounded by a red strip edged by two white pearled strips. The pearled strip separating the border from the tapestry is pale green, the border has a blue ground, the leaves being alternately white and dark purple. The enclosing band is white by custom. Here the border is in a cold tonality, pearled, and it enhances the tapestries on red ground. The subjects are also generally kept in a cold and pearly tonality, so that they are detached by the delicacy of their coloring from the strong ground of the tapestry, that serves them





as a ground; and this delicacy of coloring of the subjects is recalled by the border. The yellow medallions serve to connect the powerful coloring of the tapestry and the refined brilliancy of the subjects and borders.

Note 1.p.403. From the windows of the north transept of the church of Notre Dame of Dijon. (About 1230).

We would abridge these infinite details of the art of the glass painter, but it is difficult to be more brief, if one assumes to make a review leading to a practical result. We are sufficiently led to believe, that in questions of coloring, instinct plays the principal part; it may be useful to make known that observation and the knowledge of certain laws are no less essential to the artist, so much so that this knowledge has never been a hindrance to those, who being naturally endowed with the qualities of a colorist, are called to decorate edifices.

Before carrying farther the study of the transformations of the procedures of the coloring of stained glass, it appears necessary to return to the so essential parts of the composition and the design of the cartoons.

The little that we have said on this topic however suffices, we believe, to emphasize an important point, viz:-- that the procedures of the composition and the design of stained glass differ from the procedures of the composition and the design of opaque painting. The art of the glass painter substantially varies from the art of the painter. Light passing through colored surfaces, in regard to the relations of these colors to each other, has an effect different from that exerted on opaque surfaces; light transmitted through a design likewise modifies its outlines, causes what it does not produce, if it directly strikes on a painted surface. For example, assume two inscriptions identical in dimensions and form, one inlaid in white on a black screen, the other drawn in black on white or very light blue glass. If daylight passes through these two inscriptions placed side by side, the distance at which one can still read the inscription in white on a black ground will no longer permit the reading of the inscription in black on a light ground. The difference will be such, that if the inscription in black is read at 32.3 ft. (as the extreme limit of distance), the white inscription on a black ground can still be read at 49.2 ft.





If one recedes more, the black inscription will entirely disappear, and the white inscription will show a white glimmer on the black ground, but will not entirely vanish while the object from which it is detached will be visible. That is the effect of the radiation of light, whose effects have already been indicated, when it is transmitted through colored surfaces. In regard to the design, let us return for a moment to these effects.

The radiation of light passing through white glass on which is placed a screen, causes the parts not covered by the screen to appear larger than they really are, this being at the expense of the borders of the opening. Passing through a blue glass, the radiation of the light makes the edges of the screen indistinct and tinges bluish a zone of the enclosing opaque surface. Passing through a veined red, the radiation is manifested by very vivid sparkles, but without coloring the opaque borders in a diffused manner; if this red glass be of uniform and intense tone, the actual tint almost entirely disappears at a distance, and seems to be a spot of livid brown. Passing through a yellow glass, the radiation detaches very distinctly the edges of the opening without streaks, does not change its dimensions to the eye, but the yellow tint appears darker at the centre than at the edges. According as the green and purple tones approach blue, yellow or red, the opening left in the screen will participate more or less in these qualities.

Fig. 13 gives an idea of this phenomenon. The square C is the actual opening left at the middle of the screen. The white and the three colors will produce in this opening at a certain distance the appearances, that we present here. These aspects then have an influence on the design, that must be taken into account, and with which the artist glass painters of the 12<sup>th</sup> and 13<sup>th</sup> centuries were greatly occupied. So they employed white and yellow to outline clearly the principal forms of the glass, notably to place around the glass a margin  $\frac{3}{4}$  or  $1\frac{1}{8}$  ins. wide, that detaches it from the panels or tracery of masonry; thus they proceeded around panels of legendary glass. If they paint the lines and shadows of the design on blue, they take care to make them wider and stronger than if red, and especially than if on yellow or white. Besides, they utilized the influences of tones on each other to neutralize too powerful effects of radiation. On the white strips they paint





pearls, or a straight or wavy black line. For the clothing of figures, they avoid employing the qualities of the clear blue of the grounds, that by its radiation would cause to disappear the lines placed thereon; they use grayish, turquoise or greenish blue. The more or less firmness to give to painted hatchings producing shadows, is not indicated on the cartoon, if as we have explained above, the master has the glass cut on a line before the indication of these hatchings, the glass being cut and assembled on the painting frame and exposed to daylight, the painter increases or reduces the modeling according to the more or less radiating quality of each piece.

The influence of the tones on the design being thus recognized, we are going to examine how the masters proceeded to compose, trace and model the figures and the ornaments of stained glass works.

In their compositions, they avoided as much as possible groups of persons or of parts of ornament, so as to allow the ground to be divined throughout the entire extent of a motive. In that the composition of the glass differs from that of opaque painting. Just as it is proper in the latter to group the persons in a scene so as to detach them most frequently from each other, it is just as necessary in stained glass to separate the personages by causing the ground to appear frequently around each one of them. At a distance because of the vivid translucent tones, if the persons are grouped in a sufficiently great number, it becomes difficult for the eye to comprehend them separately. The absence of all linear or aerial perspective, the impossibility of reducing tones without making them opaque which makes a spot and produces confusion, unless one finds the ground at least by openings, that outline the contour of each figure. The same for the ornaments; not only should the leads outline them distinctly, but also the ground tone. The glass painters of the 12 th and 13 th centuries rarely failed in this elementary rule.

By an analogous reason, the movements and gestures of persons are strongly accented and exaggerated, the forms of the ornaments being very vigorously drawn. The translucency of the tones tends to soften the outlines and confuse them; it is then necessary to guard against that result by very firm, exaggerated and detached drawing; it is frequently necessary to increase the





vigorous line of the lead by a black edging; and to avoid heaviness, to leave between this black strip and the lead a strip of the pure local tone, as we have seen practised in the examples from the 12 th century. (Figs. 5, 8).

The procedure of design adopted in the 12 th century, still impressed by the traditions of the Greco-Byzantine school, was then so well suited for painting on glass, but could not be continued in France in an epoch, when the lay schools were developed, which tended toward naturalism in painting as in sculpture.

The glass painters of the 12 th century, like the Greco-Byzantines in their paintings, always sought to cause the nude to appear in spite of the draperies covering it; the most ample clothing appeared in these works as if glued on the projecting parts of the body, and was developed on side the human form as if moved by the wind. One feels in that manner of translating nature an antique tradition, a recollection of the importance given by the Greeks to the nude in their works of art. Christian ideas no longer allowed the representation of the nude; it was covered by fabrics, but so as to cause to be understood, that men did not entirely forget what had been the glory of antique Grecian art. The artist glass painters, like the sculptors of the 13 th century, studied nature as presented to their eyes, and had no reason to retain the hieratism so dear to the Byzantines. From the beginning of the century, men recognized in paintings on glass the influence of the study of nature by the manner in which were treated the draperies, in the features of the heads, the correct expression of pose. These modifications brought into the art of the glass painter by the lay school have such a value, that we believe it necessary to insist on it by examples. Fig. 3 shows a fragment of stained glass of the first half of the 12 th century entirely impressed by the Greco-Byzantine procedure. Fig. 5 already shows progress, made, a tendency toward observation of nature, in the manner in which the draperies are drawn. Now this king of Judah represented by Fig. 5 cannot have been painted before 1145, since it belongs to the part of the cathedral of Chartres that dates from 1140. Here now (Fig. 14) is one panel of stained glass from the cathedral of Bourges, replaced in the stained glass of the 13 th century, but which evidently came from the church built





during the second half of the 12 th century. <sup>1</sup> The design of this panel, that represents the two apostles Peter and Paul, still affects to subject the folds of the draperies to the nude; yet there are in the poses, gestures and the fabrication of the draperies, a tendency to free themselves from Greco-Byzantine archaism. That tendency toward the study of nature by abandoning the Greek traditions, is marked in a definite manner in the figures of angels, which accompany the representation of the Holy Virgin of the stained glass of the cathedral of Chartres, called "Our Lady of the beautiful stained glass." This stained glass shows us the figure of the seated Virgin, belonging to the school of the 12 th century. But this subject has been enclosed by borders and angels, that date from a restoration made during the first years of the 13 th century.

Note 1.p.407. It is known that at the cathedral of Bourges there still exist important fragments of sculptures belonging to the 12 th century. (North and south porches).

Attempts toward naturalism are evident in these restorations or additions. We take from that stained glass one panel (Fig. 15), representing one of the angels that hold the torches at the feet of the Virgin, entirely permeated by the archaic style of the 12 th century. <sup>2</sup> The folds of the vestment of this angel are no longer treated in accordance with the hieratic tradition of the Byzantine school; there is no longer the affectation of causing the appearance of the nude in spite of the natural movement of the draperies. The artist has further endeavored to allow the ground to appear, in order to show clearly the outline of the figure. The legs, arms and wings are detached as much as possible.

Note 2.p.407. See the whole of this stained glass window in *Monographie de la cathédrale de Chartres*, published under the direction of M. Lussus. (Drawing by M. Paul Durand).

With the style of the design, the mode of execution likewise changed.

In the stained glass of the 12 th century, the oldest half tints are used; and this essential part of the modeling of the glass merits attentive examination, since it has been the subject of discussions more extended than conclusive. Theophilus <sup>1</sup> clearly indicates the procedure employed for laying the half tints. He says:-- "When you have placed the principal shadows





on the draperies of that kind and they are dried, all that remains of the glass will be covered by a light tint, not as dense as the second shadow, nor as light as the third one, but which is a medium between the two. That being dry, with the handle of the brush you will make at each side of the shadows first laid fine lines (scratches), so that there remain delicate and clear lines between the first shadows and the second tint." Theophilus thus allows three operations for the modeling; a first consists in laying with the brush the first or rather the principal shadows; a second consists in passing over a light half tint as a glazing; then a third consisting in placing a rather intense half tint beside the shadows, taking out the lights so as to leave delicate lines between this half tint and the shadow, thus to obtain the great lights. Here the procedure is briefly indicated; by examining the stained glass of the 12 th century, let us see how this result was obtained. On this glass is indeed noted a primary work of shadows made by hatching, not a absolutely opaque, very delicate and transparent at their beginning very full at points where the shadow assumes importance, but still transparent. After this primary work, the glass is subjected to a first fixing, which Theophilus does not mention, but which is perfectly indicated by the old glass. This primary shadow being thus vitrified, cannot be changed by the addition of a second tint. The painter they laid this second tint, that made the strong half tint, and he took care to limit its extent and draw its outline by scratching the glass with the handle of his brush, particularly between this strong half tint and the shadow. He did not have to fear removing that already vitrified, which facilitated the execution of this delicate work. Did he place the lightest half tint before the more intense one? That is probable, for nothing prevented his doing so; but what is important, and of which Theophilus says not a word, is that over the burned principal shadow, dark but transparent, the painter laid opaque tints, the brush being charged with thick color, to obtain an increased shadow without translucency. The glass was placed in the furnace again, and the half tints as well as the strong lines were vitrified. <sup>1</sup> The latter are pasty with a projection very sensible to the touch; in brief are perfectly clear without cracks or fusing with the first shadow. Thus were modeled the beautiful glass windows of the 12 th cent-





century, of Notre Dame of Chartres, of the abbey church of S. Denis, of the (old) cathedral of Bourges. Let us take a bit of stained glass of the 12 th century (Fig. 16), that we reproduce at full size. With the brown color, dark but still translucent, the painter has traced the principal folds of that sleeve, then the piece was placed in the furnace. This first preparation being vitrified, he laid the half tints, while taking out the lights with a point, and the thick pasty opaque lines on the vitrified shadows. On the lower part of the elbow the painter has laid a half tint by hatchings placed on the evidently vitrified primary shadow, for otherwise the delicate lines of that first shadow would have been wetted and mixed by the liquid holding the half tint in suspension. It is evident that as Theophilus indicates, clear strips have sometimes been removed between the half tint and the shadow to recover the local tone, as stated above. The placing of the half tints on the stained glass of the 12 th century thus had great importance; it required two firings and by so much increased the cost of these works. Hence from the beginning of the 13 th century, when the greater dimensions of windows gave to the artist glass painters enormous surfaces to cover, they sought processes both more rapid and less costly. The glass is burned in the furnace but once; the half tints are laid beside and on the shadows and mix with them a little, because the brush, however lightly handled, carries off some of that shadow in laying this half tint. Further, they always use a point or the handle of the brush for clearing the outlines of the half tints and to obtain pure strips, but they can no longer have the clearness of those drawn on the glass of the 12 th century. Thus was modeled the angel of the beautiful glass of Chartres (Fig. 15). The detail A (Fig. 16) explains this procedure. Later the half tint is laid flat, the shadow line being dry, just as one would lay a water color by rapidly passing the brush slightly charged with the tint. The shadow hardly mixes with this light wash. These material means were modified again toward the end of the 14 th and during the 15 th centuries, as we shall soon see.

Note 1.p.408. Divers. Art. Sched. Book II, chap. 21.

Note 1.p.410. Our glass painters that have skillfully restored the stained glass of the 12 th century, particularly MM. Coffe-





Coffettier & A. Gerente, must have proceeded in this manner. Fr  
Fragments of this stained glass in our possession prove being  
burned twice.

There is no need of having seen many Greco-Byzantine paintings, either in manuscripts or in the monuments of the East to verify the intimate relations, that exist between the procedures employed by the Greek artists and those of the West in the 12 th century. There is the same archaic mode of tracing the folds, the same fabrication. One can easily establish the difference separating these procedures in painting from those adopted at the beginning of the 13 th century for stained glass. The style of design likewise suffers a complete transformation; the tendency toward the dramatic idea, toward expression, and the study of nature, appear in the art of the glass painter, when this art is practised by the lay schools. The pose loses its archaic charm, heads are no longer drawn according to a conventional type, the clothing is that of the time and is faithfully rendered; the execution is more free, less severe, less refined and compact, it looks for effect. It denotes a profound experience of the means practised for obtaining the most complete result by the aid of the simplest means. The dramatic tendency is particularly marked among the artists of the beginning of the 13 th century. The cathedral of Bourges, so rich in very beautiful stained glass of that epoch, is an inexhaustible mine, from that point of view. Several of these stained glass windows are executed with perfection, others evidently in haste, but from cartoons of skilful masters. Let us take one of these panels (Fig. 17), that represents the children of Jacob bringing the bloody garments of Joseph to their father. One indeed again finds here some traces of the Byzantine method; the draperies still indicate the nude at several points. But the western naturalism, the dramatic intent, appear in this composition. The figure of Jacob notably no longer has anything archaic; it is entirely inspired by true feeling, the observation of nature taken in the fact; no more reminiscences of antiquity. If we examine the details of these last examples of stained glass, we shall again be more strongly convinced of the changes, that the art of the 13 th century brought into the art of the glass painter as well as to the architecture itself. Fig. 13 is the head of a woman from the middle of the 12 th century. <sup>1</sup> In this ex-





example, one cannot ignore the antique influence transmitted by Byzantine tradition. The resemblance of this figure to certain paintings of the catacombs of Rome is striking. These are sister arts. Fig. 19 is a tracing at full size of the head of S. Paul from the panel (Fig. 14). These two examples show an execution sought to obtain an effect on account of the distance of the observer, and the radiation from the light purple tawny glass. But when the glass painters of the 12<sup>th</sup> century desired to attain greater perfection because the glass was seen near at hand, because those glass painters held to employ all the resources of their art, they arrived at results never surpassed until now; for without abandoning the principles of painting on colored glass and the broad style of drawing suited to this kind of painting, they obtained a refinement in modeling, that rivaled the most delicate works. M. A. Gerente, whose choice collection is known to amateurs, possesses a head from stained glass of the 12<sup>th</sup> century, that is a real masterpiece. He was willing indeed to entrust it to us, and we give it here (Fig. 19 bis), a tracing made with the most extreme care. In this piece may be verified perfectly the procedure of twice burning. The painter first laid the stronger half tints like a light cameo, which indicated the masses of the modeling: the piece was then placed in the furnace; then it returned for the thick and pasty painting, to form the principal lines, the black shadows of the hair and beard, and the very thin scratched lines were made with the point. The most delicate of those scratches have scarcely the thickness of a hair. They are visible on the eyebrows, the beard, and even on the top of the head. It is certain that these thick and pasty shadows, very perceptible to the touch, were placed after a first burning; for at some points this opaque enamel has scaled, and below it is perceived the primary half tint, that adheres to the glass. The lightest half tints must have been laid likewise after the first burning; for being passed over that primary half tint at several points, they have not affected that primary tint. Further, with the means of painting now in use, we cannot obtain similar results, than washed basal half tints, whose texture is not perceptible, even under a lens; our grays of iron oxide are always a little sandy, however well they may be ground. The gray placed on this head (Fig. 19 bis) is transparent, warm with a





bistre tone, and does not chill the local light purple bistre tone of the glass, as would be done by the gray of the 13 th century, or that employed by our glass painters. There is no need, we believe, to emphasize the grandeur of style of this painting, which at a distance of 32.8 ft. retains all its energy. One no longer sees a trace in this head, of the conventional forms of the Byzantine school. The mouth and eyes are drawn by a master with a wise observation of nature, no longer with the procedures of recipes transmitted to us by the degenerate Greek school. Thus we regard this work as belonging to the end of the 12 th century, to the epoch when art tended to free itself from hieraticism, without completely abandoning the perfect means of execution employed during the first half of that century. In this figure as in that of S. Paul, the artist seeks the personal expression (especially in the last, Fig. 19 bis) from the types consecrated by the Byzantines. However, between this Fig. and that we give (Fig. 20), which is traced from the head of Jacob in the panel, Fig. 17) there is an entire revolution in the art. Here the expression reaches exaggeration. This design is evidently conceived so as to produce the effect sought with the distance and the translucent lights.<sup>1</sup> This bold and powerful drawing, strongly true in its exaggeration, has nothing more of Byzantine art, and it recalls rather certain paintings on Greek vases of high antiquity. This is the moment of the climax of painting on glass, the point of contact of the last vestiges of the arts inspired by the Byzantines and the tendencies toward naturalism. Already (Fig. 21) this head traced from the stained glass of the S. Chapelle of Paris (about 1240) indicates the abandonment of the true decorative style, and the next (Fig. 22) from the stained glass of the legend of S. Thomas of the cathedral of Tours (about 1250),<sup>1</sup> visibly inclines to the dramatic. It is evident that during this period comprised between 1190 and 1250, artists abandoned the accepted types, and soon also the decorative procedures inherent to painting on glass. They always proceed by lines, the lead setting accenting the drawing of the outlines, but touches replace the broad modeling, that alone gives solidity to these translucent forms. Sometimes even, as in the example in Fig. 22, when the glass was executed very rapidly, the half tint is wanting. To better appreciate the difference in execution between





the glass of the middle of the 13<sup>th</sup> and those of the 12<sup>th</sup> centuries, we give (Fig. 22 bis, A) a head copied at two fifths full size from a fragment of about 1180, that is found in the northern rose window of the cathedral of Paris, and that very probably belongs to the stained glass of the old transept commenced under the episcopate of Maurice de Sully. Like the example in Fig. 22, this head belonged to stained glass placed at a great height, consequently destined to be seen afar and fully detached against the sky. One sees how the procedures employed by the painters differ in these two examples. Seen near, the head A (Fig. 22 bis) has a brutality in execution, that exceeds all that one could dare in this kind. Yet this head, seen at a distance of 32.8 ft. is changed into the appearance B. The glass employed is a light purple bistre. This tone, whose radiation is feeble, with the opaque shadows placed on it, produces a singular effect, that we leave to be explained by competent scientists. These shadows at a distance change by gaining on the narrow lights and lose in the vicinity of the broad lights. One can take into account this fact in tracing the head in Fig. 22 bis from the original, and by laying that tracing on a glass of the tint here indicated, as indeed M. Gerente desired to do in order to facilitate this study; place that fragment on a glass, taking care that it is detached on the middle part of the sky. At a distance of 13.1 or 16.4 ft. the leads have already vanished and are mixed with the shadows; the shadows on the side behind the face have affected the half tint, and the mouth is already modified. At 32.3 ft. distant the appearance is exactly that given by the Fig. B. Thus the lead outlining the maxillary bone, comprised between the two broad lights of the cheek and the neck is reduced to a light line, while it assumes great width under the chin, where the adjacent lights are narrow. Likewise the lead separating the front hair gains on that and changes into a cast shadow, this front light being narrow. A part of the light of the eyelids mingles with the shadow of the eyebrows, like the fugitive light extremity of the lower lip, all surrounded by shadow and mingles entirely with the shadow. The half tints aid in producing these illusions, for if then are made to disappear, and one is limited to opaque shadows, the effect is no longer the same; all the lights encroach on the shadows, that are simply reduced in depth





and do not mingle. It is necessary, that in the vicinity of the shadow, the glass be less translucent by the application of a half tint, so that the light radiates with less vividness, or that its radiation may illuminate the shadows without causing any loss of their width. We do not know whether the studies recently made on light can give scientific explanations of these phenomena, but experiments are for us demonstrations to which everyone can have recourse. It is certain that these artists so scorned have acquired a long experience with these luminous properties of colored glass, and that in this respect as in all others, they could demonstrate them to those, who today appear to make so little of their works. Here is what comprises the lost secrets of painting on glass; lost because one does not take pains to analyze the means and procedures employed by the old masters.

Note 1.p.413. Tracing from a fragment belonging to M. Oudinot.

Note 1.p.417. These tracings were furnished to us by M. Coffetier.

Note 1.p.418. This lost tracing is made half full size.

It is particularly in paintings on glass representing persons of large dimensions, that appears in an evident manner the science of observation of the glass painters. Unfortunately, there remain no figures from the 12 th century at a scale greater than human height; but of the 13 th century there are a great number in the stained glass of Bourges, Chartres, Auxerre and Rheims, and these figures are treated with that profound knowledge of the effects of light on translucent colored surfaces. Frequently in these figures of colossal dimensions, for the nude parts as well as the draperies, half tints do not exist. The gray is almost opaque and only acquires a little transparency near the borders of the touches of shadow. One can cite among the oldest figures of great dimensions a certain number of fragments from the choir of the abbey church of S. Remi of Rheims. Much of this glass dates from the epoch of the construction of the choir, i.e., from the end of the 12 th or the first years of the 13 th centuries. This glass at several times was very unskilfully reset in leads with the alternation of panels, but it was evidently executed by masters of consummate talent. Several fragments have a beautiful character and are conceived with rare skill to produce at a distance an entirely satisfactory effect. We



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have had in our hands one of those heads, which was deposited with other panels in the attics of the parsonage, and we here give a copy (Fig. 22 ter, A), at one fifth full size. The face is composed of eight pieces of a warm purple glass. The eyes are cut in a green approaching greenish white; the hair is in purple glass with a violet tinge. The crown is yellow with blue and red stones. It is entirely covered by a tint of gray, and the lights are taken out with the point, according to the procedure of the 12 th century. At the distance of 65.6 ft., this head, so brutal in execution, takes an entirely different character. These are the features of a young man with a nascent beard. We present this appearance in Fig. 22 ter, B. The lead that passes from the corner of the right eye to the side of the nose, entirely disappears in passing over the great lights, and only furnishes a light half tint at its points of contact with the shadow. The strong touch on the nose at the side of the light passes into the state of half tint and is lost at its lower end. The eyebrow of the right eye is softened by the light strip passing into the shadow. The mouth is modeled with a very youthful softness, as well as the chin. As for the crown, by its delicate incised lines, it seems a jewel modeled with the most exquisite delicacy.

The great personages represented on the stained glass of the 13 th century, such as those of Notre Dame of Chartres, frequently present these phenomena, although they are generally in execution very inferior to the example just given; yet the principle is the same. The decorative feeling is never lacking until toward the middle of the 13 th century; as for the composition of the design and the action, the artists inclined toward dramatic results. This new tendency then is very apparent in the composition of the glass of the S. Chapelle of Paris, Notre Dame of Chartres, the cathedrals of Tours and of Bourges, which date from the first half of the 13 th century. Here (Fig. 23) is a panel taken from one of the glass windows of the cathedral of Bourges, that represents the martyrdom of S. Stephen. It is difficult in a small space to better express in composition the scene of the stoning of the saint. The action is expressed with absolute truth. Yet according to our preceding statement, the persons are detached from the ground as much as possible, while forming a group. Further, the designer has not restricted him-





himself to remain within the limits of the enclosure, but passes outside them; this again contributes to the vividness of the scene. No longer is anything archaic in the folds; their drawing is faithfully given from nature. The clothing is that of the time and abandons Byzantine traditions, still so marked in the draperies of persons sculptured and painted toward the end of the 12 th century.

These new qualities are particularly applicable in the stained glass of our school of Ile-de-France, always restrained in even the most ordinary works. The stained glass of the S. Chapelle of Paris, so remarkable in the effect of the entirety, must have been executed with great rapidity: there are also discovered many negligences; glass badly burned, subjects incomplete, the execution often left to hands with little skill. Yet one can everywhere recognize the conception of a master in the composition of the cartoons. The scenes are clearly expressed, and the figures are skilfully grouped; the drawing is sometimes pure and the pose always correct. This seated warrior (Fig. 24) supplies the proof, although the execution of the details may be insufficient. It is necessary to have had in our hands a great number of stained glass works, to have analyzed them, so to speak, piece by piece, to render an accurate account of the procedures of this art. Translucent light so easily suppresses the opaque parts, like the iron bars, the leads and the heavy lines, that the painter must keep strict account of this phenomenon. Now it is not by enlarging the shadows beyond measure, that one can oppose this effect of the light, for then only obscure spots are produced, which destroy the form instead of accepting it.<sup>1</sup> Yet in spite of that suppressing quality of the light, the least false line outside of the form shocks the eye more than it would on an opaque painting. Which demonstrates that however delicate the lines may be, they have their value in painting on glass. If they are in place, they are scarcely perceived; if placed contrary to the form, they torment the eye. Frequently the stained glass of the 13 th century, executed with haste and negligence, allow to be seen insufficient or coarse work, but this work is always intelligent; every line is a stroke, accents the form, and that with the procedures inherent to this kind of painting. It is not without motive, for example, that painters give to the extremities of the members an





exaggerated smallness; the light takes pains to remedy that defect, which is apparent when one holds the piece of glass near the eye, but disappears if the piece be in its place. For example, here is a hand (Fig. 25, A), traced from a panel of the 13 th century. The hand drawn from nature would give the outline B. If the painter were content to trace it thus on the glass with the modeling, admitting that this drawing be perfect, at a distance it would only present a confused, soft and formless mass; all refinement put into the drawing and the modeling would be lost labor. By accenting the form, reducing the light and exaggerating certain details, the artist of the 13 th century obtained the desired effect at a distance, together with the pose and the outline.

Note 1.p.424. This defect is very apparent in certain modern stained glass executed like opaque painting, but strengthening the shadows.

Still this example, that we have expressly chosen, is one of those most approaching the actual form. But here is another (Fig. 26), that is much better in the requirements of translucent painting. The exaggerated curvature of the index finger, the great size of the end of the thumb, are made to emphasize the pose and oppose the light by facilitating the understanding of the form. By the use of those procedures the subjects of our legendary stained glass of the 13 th century are so visible, though generally of very small dimensions, that the scenes can be recognized, and the figures composing them seem alive, as if they were acting. It occurs frequently to us to touch these panels with the finger, which at a distance produce an excellent effect, and to be surprised by the means employed by the artist glass painters to obtain that effect, the exaggerations and tricks allowed to them. The figures that appear most perfect, when seen close, have a singular strangeness, from the point of view of rigorous drawing. Parts of these figures are slender and out of all proportion, others are drawn with exaggeration; the pose is forced to impossibility, lines accented to heaviness. The panel from Bourges that we give, Figs. 17, 20, and whose appearance is excellent at a distance, presents to a near view all the means of forced execution, that we mention. The head, Fig. 20, in that respect is one of the works most interesting to study. Long practice in these effects of





light and distance is required to arrive at that exaggeration of the form, to that boldness justified by the effect obtained. It is clear that the more complex are the subjects and the more varied the scenes, the more the artists must have had recourse to these procedures, which consist in playing with the light to obtain a desired effect; for in the figures of a simple composition, they remain nearer the reality. The personage given here (Fig. 27) is in the last case. <sup>1</sup> The painting on glass is the drawing A, the appearance at a distance is the drawing B. The leads disappear in the light; the hardness of the lines vanishes, composing a soft and clear modeling. Yet the half tints and the shadows are placed flat without blending; but the vicinity of the parts left without any work and the vicinity of the lights influence these tints and absorb the outlines, so much that at a distance, one would assume a very delicate modeling, a succession of tones between shadow and light, that in fact does not exist. If on the contrary this modeling was softened; if instead of being composed of touches of shadow of the same value and a very small amount of half tints of uniform intensity, the painter had followed all the transitions given by nature between shadow and light, this figure at a distance would present only a confused mass, or rather dull, soft and round forms without accent. Now this defect shocks one in the glass, that much later was treated like opaque painting. The traditions of the 12th century remained in certain provinces until about the middle of the 13th century. It is in Ile-de-France and in Champagne, the art of the glass painter tends toward the more attentive study of nature, in Burgundy for example, one again finds at the middle of the 13th century traces of this Greco-Byzantine drawing and modeling. The glass of Notre Dame of Dijon, that of Notre Dame of Semur, which date from 1240 to 1250, and are therefore contemporaneous with that of the S. Chapelle of Paris, have an archaic character already lost in the French provinces. This S. Peter (Fig. 28) drawn from glass in the chapel of the Virgin of Notre Dame of Semur furnishes us with an example of the little changed procedure in design of the 12th century. Besides this glass is executed with minute care. The artists feared the great areas of light; they multiplied the work in the folds of draperies and the lines to lessen the effect of the translucent coloring; there results a harmony sli-





slightly heavy, but of sustained value. The glass chosen by this school is particularly beautiful and thick with a velvety coloring. Unfortunately there does not remain a great number of these Burgundian stained glass windows, for the stained glass of the cathedral of Auxerre does not belong frankly to this school, and rather approaches the fabrication of Champagne. Let us also say, that in the glass of the same edifice and of the same epoch is observed the works of very different hands. Old and young artists worked at the same time, and if the young workers introduced in the works an advanced and novel execution, the painters belonging to the school of the past continued to employ their procedures. Thus for example, at the S. Chapelle of Paris, one notes panels, that have retained traces of the fabrication of the beginning of the 13<sup>th</sup> century. Perhaps in the 12<sup>th</sup> century trade glass was made hastily and carelessly. Of this sort of glass no traces remain. It is true that the glass work of that epoch, that is preserved, was replaced in the 13<sup>th</sup> century or exceptionally left in place,<sup>1</sup> which causes the supposition, that this preservation was due to its perfection, while the works of an inferior order were replaced. We always know only, that the stained glass of the 12<sup>th</sup> century was incomparable in beauty, in choice of glass, composition or execution of the ornaments, or the setting in leads: one cannot say as much of the glass made during the 13<sup>th</sup> century, particularly of that belonging to the second half of the century. Its harmony is not always happy, its composition is often careless and the execution is defective; the stained glass is irregularly fired and rudely set in leads. These negligences are explained, if one takes into account the prodigious amount of glass then required from the glass painters.

Note 1.p.427. From panels of S. Chapelle.

Note 1.p.430. As for example, in the apsidal chapels of the abbey church of S. Denis, in the cathedrals of Mons, Bourges and Chartres.

It is unnecessary to believe further, that this decorative procedure was obtained at a low cost, for stained glass must cost very dear. Some guild gathered its resources to furnish one stained glass window,<sup>2</sup> and generally these stained glass windows given by a trade guild are the most beautiful in execution among those decorating the windows of our great cathedrals.





A prince, a canon or an abbot gave a window. Thus these were articles of price. The value of the original materials was considerable and men attached much importance, and not without reason, to the good quality and beauty of the glass. The setting in leads must naturally reach high prices. Leads were not obtained by drawing as today, but by planing, that required much time and care. When one computes the number of linear yards of leads that enter into one panel of legendary stained glass, for example, he recognizes that there is a considerable value of material and labor. Today the setting wall in leads of a square foot of legendary thick stained glass costs about \$1. The glass being much less uniform in thickness than ours, during the 12 th and 13 th centuries, the cost could not be below that, taking into account the value of silver. So that we have said, that this irregular thickness of the glass, that makes so difficult the setting it in leads, is one of the conditions of harmony and of vivid tones. When the glass is flat and uniform in thickness, the light strikes a window at the same angle, from which results uniform refraction; but when on the contrary this glass is bent and irregular in thickness, it presents externally to the light, surfaces not all in the same vertical plane; from which results a varied refraction, that singularly adds to the relative brilliancy of the tones and contributes to the harmony. Then the perfection of the product is often in inverse relation to the quality of the effect, in the matter of art.

Note 2. p. 430. At the cathedrals of Chartres, Bourges, Tours, Auxerre and Troyes.

To set this glass of unequal thickness and bent, the glass setters of the 12 th and 13 th centuries employed leads rather large but with much space, planed from ingots (Fig. 29). The flanges of these leads being thick allowed the workman setter to bend them down on the inequalities of the glass with a stick, so as to hold their edges perfectly, as done in setting a bezel. The sections of these leads, sometimes very small, gives either flat plane or externally convex surfaces (B). Their width being large in proportion to their depth permits bending them easily to follow all the curves of the pieces of glass. They were joined by soldered points. The leads that we still have, dating from the 12 th century, are very narrow; they generally become wider in the 13 th century, especially in glass work with great subj-





subjects, and between them and the glass, one frequently notes the presence of a fatty resinous substance, intended to caulk the crevices.

If the artists of the second half of the 13 th century sometimes carelessly executed glass works, it must still be recognized that they produced a great quantity, whose appearance leaves nothing to be desired from the point of view of harmony of tones, design and execution. Among the latter we will cite the panels of the gallery of the choir of church S. Urbain of Troyes (about 1245). Three of those panels placed in the north aisle are executed with rare perfection. They are detached on grisailles; their grounds are red, green and blue, damascined with designs of extreme delicacy applied on a tint laid on the back of the glass and not on the painted side, which gives a particular softness to these designs. The three subjects represented are; the entry of Jesus into Jerusalem, the washing of the feet, and Jesus disputing in the synagogue. Here (Fig. 30) is a copy of the last subject. This panel is only 1.3 ft. wide; the figures are modeled with half tints partly placed on the back and lines painted inside according to custom. The heads seek individual and dramatic expression, but lack the grandeur and style found in the glass preceding that epoch; the draperies are evidently studied from nature, and no longer is to be perceived a trace of the seeking for the nude, still apparent at the middle of the 13 th century. Fig. 31 reproduces the head of Christ at full size; one would believe with difficulty that scarcely a century separates this painting from that given in Fig. 20. It is true that these three panels of the church of S. Urbain are exceptional, that these are miniatures on glass. They prove no less the degree of advancement of the art of the glass painter, the complete abandonment of the traditions of the 12 th century, the tendency of the new school toward naturalism and even mannerism.

Until then it was uncommon for colored panels to be surrounded by grisaille grounds. M. Steinheil, whose knowledge of painting on glass is well known, however mentions colored panels from the end of the 12 th century detached on ornaments likewise colored, but on a white ground.

This glass belonged to the cathedral of Chalons, that although dating almost entirely from the 13 th century, retains na-





numerous fragments of the glass of the 12 th century, among others very beautiful borders. We reproduce here the drawing of these ornaments on a white ground, that encloses the panels with legendary subjects on a blue ground. The entirety of the glass work gives the compartments presented at A (Fig. 32). The subjects are distributed in the quadrants of the circle c. At B is traced a detail of the spandrels d. We have indicated by letters, according to the method already given, the colors of the glass in this detail; i.e., the letters b, r and j indicate blue, red and yellow; the letters a, e, i, o, u are white, deep purple, light purple, emerald green and turquoise bluish-green; the yellow j of the circle is straw yellow, that j of the ornament being warmer. The harmony is severe, pearly, and strongly accents the medallions with subjects. This rare fact today;-- the glass of the 12 th century being uncommon, -- must have presented itself quite frequently at that epoch, we think, the tendency of the glass painters of the 12 th century being to design clear harmonies of limpid appearance. There exists at the cathedral of Augsburg glass, whose large figures appear to date from the end of the 12 th century, and are detached on white grounds damascened in grisaille.

legendary glass or that with great figures of the 13 th century on the contrary, has a powerful tonality, and the artists of that epoch did not think that this strong coloring could ally itself to the lightness of the grisaille. Yet however extensive were the glazed surfaces in the monuments, their coloring rendered the interiors of the naves very dark. From the second half of the 13 th century, they thought of giving more light in the interiors of edifices by composing the glass partly of grisaille, partly of colored panels. One conceives readily, that this innovation must completely change the conditions of harmony. The pearly white surfaces of the parts in grisaille must cause the adjacent colored surfaces to appear heavy and dark. Thus they introduced into the latter large clear portions, limpid and greenish blues, yellows, reds and very light purples, greenish or rosy whites. Besides the legendary panels or the great isolated figures were always surrounded by a blue ground, most frequently with enclosing strips. Besides the great mass of light, they thus obtained a notable economy over the stained glass of the great edifices, for the grisailles, even





those most elaborate, did not cost half the price required for the colored glass. In the high windows of the cathedral of Auxerre, that date from the second half of the 13<sup>th</sup> century, there had already been attempted the use of this means, but there the grisailles are very broad and firm in design, which opposes the too great lucidity of those light uncolored surfaces, contrasted in the same window with the colored surfaces. The grisaille occupies only a small portion of the glass, and composes a sort of margin between the principal subject and the always colored border. Here is an example taken from the high windows of the choir of this cathedral (Fig. 33).<sup>1</sup> The ground of the figure and of the canopy over it is blue; the tones of the canopy are white, yellow, pale green, with red touches in the two little side openings. This very light harmony serves as a connection between the two bands B of the grisaille. It was the same for the plinth, now destroyed and replaced by a panel of the 16<sup>th</sup> century; the figure wears a robe of emerald green, a light purple mantle, a green cap with a white band. The border is composed of bluish green and yellow leaves on a red ground. The light given by those kinds of windows is the more brilliant, when they are detached against the upper part of the sky. To oppose the overpowering effect of this light in the bands of grisaille, these are painted with thick lines with close latticing between the ornaments, so much that near the eye the surface of the lights is less important than that occupied by the opaque grisaille. In the same windows of the choir of the cathedral of Auxerre, grisailles occupying the same place are mingled with touches and strips in color. The effect is less frank and less intelligible. However to this last system the glass painters of the end of the 13<sup>th</sup> century adhered in the composition of many windows with large subjects or figures. The charming panels of the windows of the gallery of the choir of the church S. Urbain of Troyes, a specimen of which has been given (Fig. 30) are comprised between compartments of grisaille with colored strips. The high windows of the same church present a series of great figures of prophets with canopies, detached from a blue ground and comprised between panels of grisaille with colored strips (Fig. 34). The vestments of these great figures are generally clear and vivid. The borders are broad and solid in tone. That of the window here given is composed of the





arms of France; i.e., of a blue ground charged with fleurs-de-lis (yellow), without number, and a shield of gules (red) with a cross in argent (white), and four keys of the same in the four cantons (quarters), the wards upwards. Contrary to the mode adopted at Auxerre about forty years earlier, the grisaille of S. Urbain is refined, clear, little charged, in a manner to allow the gleam of the strips and the touches of color. This system was adopted in many monuments of the end of the 13 th century and of the beginning of the 14 th, notably at S. Ouen of Rouen, in the cathedrals of Narbonne, Amiens,<sup>1</sup> Cologne, etc. Sometimes the architectural canopy assumed great importance and was composed of clear tones, white, yellow, water green, with red and blue spots. During the 13 th century these canopies, although always in clear tones, are simple in design, little important in dimensions. They assume more space at the end of the 13 th century, and during the 14 th frequently occupy as much surface as the figures, that they crown. They are charged with architectural details, such as turrets, gables, rose windows, windows with mullions, crockets and cross flowers. Until then the architectural forms represented in the glass are translated into an entirely conventional manner; but toward the beginning of the 14 th century, the artist glass painters affect the more real imitation of these forms. One can cite as a first example of these attempts, the glass work of the chapels of the cathedral of Beauvais, that date from about 1310. Fig. 35 at quarter full size gives a part of the architectural decorations accompanying the subjects of these works in glass, and which are of extreme delicacy. The tones of this architecture are white and yellow with some red touches on a blue ground. The non-radiating gleam of the yellow acquires the clarity and delicacy of metallic lights through these broad accented black designs, which produces a striking effect.<sup>2</sup> But this attempt with this meagre and cut-up design, causes regret for the richly colored grounds, wide borders, the ornaments so lavishly composed, that give the glass of the 12 th and 13 th centuries that velvety and profound harmony unequaled elsewhere. The borders of the 14 th century are generally narrow and are composed of designs of too small scale. The mullions which then divide the windows into vertical compartments of a width of 2 to 2.5 ft. compel the glass painters to reduce the borders and to diminish the isolated





figures. The spaces assigned these artists had no more width than we see them take during the 12 th century and until about 1230. The iron framework only forms cross-bars, i.e., horizontal bars, and the panels comprise the central composition and the border. The example in Fig. 34 is already exceptional for that epoch; but at S. Urbain of Troyes, the spaces occupy an enormous surface; it is rare that the panels of stained glass between mullions have that width after the second half of the 13 th century.

Note 1.p.435. See the entirety of this window in the work of R. P. Martin. Also the work of M. F. de Lasteyrie.

Note 1.p.437. There remains at Amiens only traces of this stained glass in the triforium of the choir.

Note 2.p.437. The tracings of this glass were sent us by M. Oudinot.

The legendary glass of the 14 th century is much less common than that of the 13 th. This art then visibly declined; the principles of translucent painting that we have explained, and that directed artists for two centuries, were lost like the principles of monumental sculpture. Two causes contributed to this collapse of the art of the glass painter; the search for the real and for dramatic effect, the less abundant resources in the midst of a society, within which civil life developed itself more daily. The guilds were occupied with their material interests, and no longer gave those beautiful stained glass windows, that had decorated the cathedrals and the parish churches during the first half of the 13 th century; the bishops and the chapters had great difficulty in completing their cathedrals remaining unfinished, and could not devote important sums to the execution of those marvellous paintings. Lay feudalism was already greatly impoverished, and only thought of fortifying itself in its castles. Also in the religious architecture then in favor, the surfaces of the windows had been so increased, that it became impossible to fill these areas by glass with subjects, without exaggerated expense. Thus it is a rare fortune to find a church of the 14 th century in France, that presents a complete example, or nearly so, of a set of stained glass windows made at a single spurt from 1320 to 1330; this the old church of S. Nazaire, the old cathedral of Carcassonne. (Arts. Cathedrale, Fig. 49; Construction; Figs. 109, 111).





The choir and transept of this church presents an enormous surface of openings all filled with their stained glass of the beginning of the 14 th century. <sup>1</sup> This glass with legendary subjects has a brilliant harmony without being excessive, which is rarely found at that epoch, and belongs to a school with a centre unknown to us, but which we should be disposed to place at Toulouse, and whose products are found even to Beziers.

Note 1.p.439. In the choir, two of the old glass windows were alone replaced in the 16 th century. These two Renaissance windows are also excellent in execution.

The panel (Fig. 36) from the window containing the legend of S. Nazaire gives an idea of the style of the school; <sup>2</sup> the compositions are very good, the dramatic feeling is labored, and the pose therefore often falls into mannerism. The draperies are less understood than in our northern schools, but the choice of the tones, the entirety of the general harmony, count for much on what is done north of the Loire at that epoch. The glass is coarsely made, excessively irregular, thick, but with very beautiful value of tone. Some parts appear painted by skilful hands, as for example the figure of the woman in the panel (Fig. 36), and are executed with much spirit and skill. Among these glass windows of S. Nazaire must be cited that representing Christ on the cross, with the temptation of Adam, the prophets holding scrolls on which are inscribed the prophecies relating to the coming and death of the Messiah, as one of the most remarkable by its composition, choice of tones and firm design, solid, well-modeled, and worthy of the finest glass painters of the 13 th century.

Note 2.p.439. S. Nazaire caring for the poor, the widows and orphans.

To be dated from this epoch (beginning of the 14 th century), except some glass quite remarkable for the general entirety of the effect, the design visible tends to mannerism. As for color, the beautiful harmonies of the 12 th and 13 th centuries are lost, and the painters seek brilliant tones contrasting with the grisaille tones. The silver yellows were recently discovered, take too great a place and give a tame appearance to the glass. men seek to fill the grounds with a meagreness and with too forced a modeling. Large figures are avoided and grisaille daily assumes more importance. One no longer knows as before how to





establish a distinct difference between the art of the painter on a wall or panel and the art of the glass painter; on the contrary, the painting on glass daily tends more to seek the effects suited to opaque painting.

The disastrous state of France during the last years of the 14 th century and the first half of the 15 th scarcely allowed glass painters to exercise their talents. Thus the glass of that epoch is very rare, and the little that remains to us of those works is of mediocre value. Yet grisaille glass was made, and the art was not lost, since toward the end of the 15 th century it is seen to resume new life, but in conditions foreign to the older art. Three principal schools then appear, the school of Ile-de-France, that of Troyes and that of Toulouse; the latter was certainly the most elevated from the point of view where one must place it as relating to translucent painting. The school of Ile-de-France places on glass compositions just as suitable and even more so for opaque surfaces. For example such is the glass of the rose window of the S. Chapelle, which dates from the end of the 15 th century. The school of Troyes varies less from the conditions adapted to translucent painting; it still possesses a very just feeling for the harmony of tones, and the subjects are treated in a manner to profit by the qualities essential to stained glass. As for the school of Toulouse, it sometimes attains perfection; its style in design is broad and elevated; its value in the use of translucent colors rivals the best works of the 13 th century. But it is rarely in the beginning of the 16 th century, that this school reaches the climax. The glass of the cathedral of Auch,<sup>1</sup> that of the churches of Lambez and of Fleurance, are really very beautiful and with a tonality powerful and harmonious. Besides the glass painters of that epoch in the north and south had found improvements in the details of manufacture, that allowed them to produce effects unknown before. They flashed certain glass, red, green, light blue, reddish brown and purple, and by removing on the wheel a part of these flashings, as done to-day for the so-called Bohemian glass, they obtained embroideries, and delicate details, which they could still color with silver yellow or certain enamel colors.<sup>1</sup> However, these colors, charming on the glass of an apartment, are completely lost in grand monumental decoration, and add nothing to the effect. The





palette of the glass painters was enriched by new tones. This means of flashing allowed them to obtain certain tones of a power unknown until then; they had violet glass obtained by a red flashing on pale blue, greens obtained by means of several layers of white, yellow and blue glass superposed, <sup>2</sup> reddish brown purple produced by a yellow layer on purple; they also already employed enamel colors on white, so as to obtain soft and mixed colors, pale blues, rose (purple of gold) and lilac. The rose window of the S. Chapelle of Paris furnishes many examples of these applications of enamel colors, which one does not know how to make today.

Note 1.p.441. See *Monographie de la cathédrale d'Auch*, by M. abbe Caneto.

Note 1.p.442. See the beautiful stained glass window of the tree of Jesse in the church of S. Etienne of Beauvais, that presents a prodigiously skilful use of these procedures to remove on the wheel.

Note 2.p.442. We have in our hands one of those green glasses from one of the windows of the 16 th century in the cathedral of Carcassonne (S. Nozair), which is composed of a greenish white layer, a yellow layer, a white and a blue one, a thin white sheet and a yellow layer. We are inclined to believe that this glass is of Venetian manufacture.

But all these improvements in manufacture could not restore an art, that abandoned its true principles. The last beautiful stained glass in the Renaissance, that is seen at Bourges, Paris, Vincennes, Sens and Troyes, are only from cartoons of painters transferred to glass. These works may have great qualities in composition, design and modeling, but have none from the decorative point of view. Their appearance is confused, dull or hard; the eye painfully seeks a design, that it would prefer to see on an opaque surface; the leads, instead of facilitating comprehension, obstruct it, because the design was conceived without taking them into account. The perspective and succession of planes absolutely lose their effect and produce only weariness.

We voluntarily agree that the manner of the 15 th century and even that of the 14 th was a sad deviation from the art among glass painters, but then still the great ornamental principles of this art were not forgotten. Yet we prefer these defects





or weaknesses to the pedantry of the artists of the 16 th century, who pretended to transfer to glass compositions more or less inspired by paintings of the Italian schools of that time, and to show their talents as designers, they absolutely neglected to observe the conditions alone adapted to translucent painting.

We should not omit to speak of a school of painting on glass, that although not belonging to France, yet has not failed to exert an influence on the schools of the adjacent provinces of the East. Just as the Rhenish architecture of the 12 th century pushed its shoots even into Lorraine and also lower Champagne, so the school of Rhenish glass painters somewhat permeated our French ateliers. Within this Rhenish school the traditions of the 12 th century were prolonged very late, both in style and in procedures of fabrication. Also in the 13 th century glass was made at Strasburg that seemed to belong to a very much earlier epoch. The figures retain their archaic character, and the ornamentation is entirely impressed by a very pronounced Romanesque style. In France from the middle of the 12 th century, the ornamentation possesses its particular charm, which is perfectly distinguished from the design still admitted in sculpture; it is not so in Alsace even at the beginning of the 13 th century. The painted ornamentation of the glass is inspired by the same models, that have served for the composition of architectural ornaments. The procedures employed in painting on glass have a stiffness not found in our glass. Dating from the 13 th century, grisaille is destined to form the design and the shade lines are absolutely black and opaque, the half tints being composed of hatchings, and they do not have the warm translucency of our tints. Here (Fig. 37) is a border of ornament of the windows of the nave of the cathedral of Strasburg, that shows how strongly Romanesque traditions were still retained at the middle of the 12 th century, and how much this design approaches the forms accepted in sculptured ornamentation. The tones of this glass further approach the habitual coloring of the 12 th century; they are light; the whites, light blues, yellows and greens dominate. Thus the animals and heads are light blue, the circles are white, the leaves being emerald green and straw yellow. The grounds are red; the strip at the left is turquoise, the pearled band beside it is golden





yellow; the strip at the right begins white, then purple plates alternate with yellow rings between which is a green; a blue strip is placed against that border, and near the circles is a white strip. Sapphire blue and red occupy the least space; light broken tones are in the majority. An architecture in tones of green, white, yellow and light blue, composed of two columns with an archivolt, adds to these borders and encloses the red ground from which are detached the figures, likewise kept in limpid tones.<sup>1</sup> As for the flesh, the Rhenish glass painters generally employ glass less colored than that chosen by our French artists. We reproduce here (Fig. 33) a head of a figure (S. Timothy), that is seen in a window of the chapel of S. Sebastian adjoining the church of Neuweiler. This glass window, of which only the upper part remains, appears to belong in style to a very early epoch; yet the form of the letters of the inscription placed above the halo cannot carry this glass beyond the middle of the 12 th century. The character of the head of the saint is entirely impressed by Greek tradition, and recalls the most ancient mosaics of S. Mark of Venice;<sup>2</sup> here the half tints are laid by hatching, retouched at several places by the scraper. On the whole, the execution of this glass does not indicate the skill observed in the example, that we have chosen. (Fig. 29 bis).

Note 1.p.444. This glass of the cathedral of Strosburg is seen today in the windows of the northern side aisle of the nave, which dates from the 13 th century, but it evidently has been replaced there and belonged to the church of the 12 th century. The style of the figures leaves no doubt on this point.

Note 2.p.444. The fac-simile of this glass was sent me by M. Steinheil. The chapel to which it belongs passes for having been built under Charlemagne, and indeed its construction may date from that epoch; but we do not think that the glass given here can have been painted before the beginning of the 12 th century.

Only at the end of the 13 th century the Rhenish glass painters appeared to entirely abandon the traditions of the art of the 12 th century. Also at that epoch, as proved by the construction of the choir of the cathedral of Cologne, that the style called Gothic took possession of architecture. The master architects, like the master painters, then desired to excel the French





models, that served them as types, they pretended to go farther, and already at that epoch fell into the style of mannerism, that we only see appear in our procedures fifty years later. Yet a certain (old) stained glass of the choir of the cathedral of Cologne possesses qualities of design and of style that cannot be slighted; as for the harmony of tones, it seems left to chance, and takes no account of the rules still so well observed by our artists during that period.

How can it be explained, that in France we have lost those qualities of colorists so evident in our glass and our paintings of the 12<sup>th</sup> and 13<sup>th</sup> centuries; qualities whose traces may be followed until the 16<sup>th</sup> century, and which from that time daily disappear from our edifices to take refuge very rarely in some easel paintings of our painters? Perhaps to the badly understood or badly directed study of the works of antiquity and of the Italian decadence, we owe the loss of that faculty possessed by our predecessors. Disdaining their works, it was entirely simple no longer to take account of the instruction they furnished. Rather than return to it, men preferred to admit once for all, that the French are not born colorists. A Among us men love to give to prejudice a sort of dogmatic consecration, that leads well to indolence of mind; this is a fatal obstacle against which we easily persuade ourselves, that our will or reflection cannot react; conscience being satisfied, one dispenses with all effort. It is very certain that the feeling for and experience in colored harmony has been lost in France for more than two centuries, and the pale attempts made in our days to color its architecture are a proof without reply. For example, is it not a mistake in the conditions of colored harmony applied to architecture, to assume that a happy effect will be obtained by introducing marble as an element of color in the middle of a stone structure? Marble with a warm and often hard tonality, that has broken reflection, cannot ally itself to the light and transparent tones of stone, it is yet worse if the marble is employed with metal with sparkling lights. Then the stone loses all solidity to the eye, its tones and even its form become soft and heavy. One desires to dig into it, to redesign its edges and outlines.

No people that has left esteemed architectural works, has ever fallen into so profound an error. The Greeks colored white





marble, that they employed because of its fine texture; but they colored it as a whole, and never attempted to place colored marbles beside white marble, and particularly beside limestone. The Romans, who had no very elevated feeling for harmony, never employed colored marbles simultaneously with stone left in its normal state. S. Mark of Venice, that presents externally and internally a colored harmony with such a happy effect, is entirely covered by slabs of marble of a very fine tone, mosaics and gilding; one sees not a trace of stone. The artists of the middle ages admitted painting to the exterior and interior of their edifices; but painting has not the rigidity of marble; one does not submit to its tonality, but seeks for and finds it. They had painting for the interiors of the great naves. The coloring of the glass had the advantage of casting a veil on the opaque surfaces, a colored glaze of extreme delicacy, when necessarily the glass itself had a harmonious tonality. If the resources at their disposal did not permit them to adopt an entirety of colored glass, or if they desired the light of day to enter interiors in a purer manner, they adopted that beautiful decoration by grisaille, which is again a colored harmony obtained by the aid of long experience of the effects of light on translucent surfaces. Many of our churches retain grisaille glass closing either all their openings, or only a portion. In the last case, the grisaille is reserved for the side windows, that can only be viewed obliquely, and then the colored glass closes the end openings, the apsidal openings seen from far in front. These lateral grisailles are always sufficiently opaque, that the solar rays traversing them cannot light from the exterior this colored glass. Yet these solar rays cast at certain hours of the day a pearly light on the colored glass, that gives them a transparency and indescribable delicacy of tone. The lateral glass of the choir of the cathedral of Auxerre, half grisaille and half colored, then places on the entirely colored apsidal window a glazing with an agreeableness, an idea of which cannot be formed. The gleam of the opaline white light passing through these lateral openings, and that forms a veil of extreme transparency beneath the high vaults, is traversed by the brilliant tones of the end windows, which produces the sparkle of precious stones. Then the forms seen to vibrate like objects seen through a sheet of clear wa-





water. The distances are no longer appreciable, they assume depths in which the eye is lost. At each hour of the day these effects are modified, always with new harmonies, whose causes one cannot weary of studying, when he always holds to studying the causes of the effects perceived by the senses; now the more profound this study, the more one marvels at the experience acquired by these artists, whose theories on the effect of colors (admitting that they had them) are unknown to us, and which the most friendly among us treat like frank children. Not admitting that frankness alone can arrive at results so complete in art matters; being well convinced on the contrary, that to artists is necessary a very superior knowledge of causes and effects to produce works always successful, and that in vast monuments, we are going to attempt to give a survey of the system adopted by the glass painters of the middle ages in the composition and manufacture of grisaille.

The most ancient grisailles known do not date before the 13<sup>th</sup> century, and these first grisailles are not combined with any colored portion.

There certainly existed in the 12<sup>th</sup> century stained glass simply composed of ornaments very light in appearance, and in which consequently grisaille filled an important part. But of these kinds of glass we know only a single example, and this one had been so disfigured by coarse restorations, that we could not regard it as complete. This refers to the celebrated stained glass work of the abbey church of S. Denis, in which were seen griffins in the middle of square panels. If one refers to a drawing that Percier made of this glass at S. Denis, before it was transferred to the museum of French monuments, these griffins formed the middle of the glass, which possessed three broad borders of ornaments in which white occupied a great surface. But this drawing would produce the assumption, that these griffins of the 12<sup>th</sup> century and their panels were enclosed much later, perhaps in the 16<sup>th</sup> century.<sup>1</sup> Yet one can conclude from the existence of these fragments, that in the 12<sup>th</sup> century was made glass of ornaments with coloring.

Note 1. p. 448. The stained glass in question here was faithfully reproduced in the work of M. Gailhoubaud, "L'architecture et les arts qui en dependent," Vol. 2. But that reproduction gives with the griffins and their enclosure of the 12<sup>th</sup> centu-





century, restorations without character and a deplorable harmony of tone, made thirty years ago.

Pure grisailles, of which we have examples from the beginning of the 13 th century, must still have existed before that epoch, for the design of those that we possess emphasizes the trace of traditions preceding the 13 th century. In the storerooms of S. Denis, at Chalons-sur-Marne, at S. Remi of Rheims, are still found fragments of painted white glass, that very probably came from grisailles of the 12 th century. These old remains are powerfully modeled with half tints, according to the method adopted for colored ornaments. The drawing is full, broad, strongly retraced with grounds relatively reduced, and filled with a lattice in black or scratched on black with the point. The glass employed is thick, slightly greenish or smoky, often filled with bubbles, which gives it a very precious sparkling quality. Usually, this white glass is not very fusible and has been changed less by atmospheric agents, than the colored glass, which is deeply marked, particularly in the South. <sup>2</sup>

Note 2.p.448. Notably at the cathedral of Chartres, certain glass is so pitted and covered with lichen, that it has lost all translucency. It is necessary to state that the glass of the 13 th century is more changed than that of the 12 th, which would cause the supposition, that already in the 13 th century, men had sought by fluxes to make the glass more fusible. On this account, the stained glass made today will be lost in two or three centuries.

Here (Fig. 39) is a grisaille from the abbey church of S. Jean-au-Bois near Compeigne. It is entirely without colored glass and dates from about 1230, although it still retains the character of the design of the 12 th century, especially in its border. It is particularly in these compositions of grisailles, that one can recognize how the artist glass makers knew how to profit by the lead setting to strengthen the design. The leads form the principal compartments, combined so as to avoid too fragile acute angles. From that point of view, the beautiful panel traced here (Fig. 40), from the chapel of the Virgin of the cathedral of Auxerre, is a masterpiece of composition. This grisaille is likewise without colored glass; it occupies a wide window, and each square is 1.6 ft. from corner to corner. A white border with plain strips encloses it. Its appearance is





pearly white with an extremely refined and soft tone. In the two examples, the grounds are covered by a quite firm black lattice made with the brush; some half tints are laid on the shadows of the leaves in broad hatchings. The design is an opaque blackish brown grisaille, slightly transparent at the edges. The cathedral of Soissons has in its nave grisailles of the 13th century without color, with a grand decorative effect; the lines of the design are broad and complete; some glass presents varieties of white to better accent the principal framework of the composition. There was a resource of which the glass makers of the 13th century did not deprive themselves. But they did not place uniformly that white glass of different qualities. For example, sometimes the framework of the composition is detached on the greenish ground by a slightly smoky tone, and then the contrary occurs; so that the artist obtained thus the shot effect of silk damask in which as the light strikes the surface, the design appears in a dark tone on a light ground, or in light on a dark ground.

The end of the 13th century still employed grisailles without color. The cathedral of Troyes furnishes us with beautiful examples of these uncolored glass windows. We give here two panels (Figs. 41, 42), whose execution is extremely refined and in charming composition. These grisailles appear to date from the last years of the 13th century. But colored borders already accompany them, while always leaving a white strip between them and the panel of the opening. We have seen that at this epoch the glass makers frequently employed grisailles with figures colored on a colored ground; but before the 16th century we know of no example of figures painted in grisaille on white glass. Yet the artists of the 14th century had employed opaque relief painting for the figures in certain cases; it then appeared surprising that they did not have the idea of doing this for translucent painting, or that if they did so, no fragments of it remain to us. Observing attentively the effects of translucent painting in grisaille, still one takes account of the reasons, that prevented these artists from applying this procedure to figures. However clearly composed may be glass work of ornaments in grisaille, however vigorous the design, so well accented are the grounds, there always results from these compositions an effect glistening to the eye, that re-





recalls the appearance of a damask fabric, i.e., a vibrating entirety whose pattern cannot be determined without wearisome attention. The essential condition of all uncolored grisaille is, that there remains no glass surface not covered by the work of the brush. There is necessary a uniform and regular distribution, so that the eye may not seem to find a hole, a void in the translucent surface. Now in painting figures, it was necessary to leave unequal light surfaces more or less large, on account of the modeling of the form. There results from this a series of luminous and dark spots scattered without order, which produced a very bad effect, and did not invite the eye to rest on these surfaces. At a distance the whites assumed too much importance, and the shadows were reduced and formed spots. One can render an account of the disagreeable appearance of these subjects in translucent grisailles, if he examines certain glass of the Renaissance, where it was sought to render very slightly colored cartoons. The eye has great difficulty to distinguish the figures, to follow their contours and the modeling through those intermingled lights and dark spots.

It is not with grisaille glass as with colored glass; one can rest the eyes on the latter without weariness, if its coloring is harmonious, while the grisaille is only made to give a translucent tapestry, that does not prepossess one. The glance cannot rest long on that glistening surface, that seems to vibrate, and which causes dazzling, if one persists in tracing the design composing it. All those that have attempted to draw grisailles in place have experienced that effect, while one can copy without fatigue a colored glass window. It was then sensible not to paint subjects in grisaille.

One can admit that the phenomenon of vibration produced by modeled glass, and thus the necessity of not having beside colored surfaces those entirely uncolored, caused glass painters to mingle colored strips in grisailles. That change made them more easy to understand, outlined them more distinctly, and took from that shot effect, which became insupportable, if the windows occupied a great area. That was indeed when the glazed openings occupied all the space left between the piers and the side arches, that men renounced uncolored grisailles. The last panels that we have given, and which belonged to the cathedral of Troyes, occupy narrow windows without tracery; but when





it concerns wide openings with tracery, like those opened in our interiors after the middle of the 13<sup>th</sup> century, the glass painters renounce the uncolored grisaille; they stripe it with red or blue strips, sprinkle it with rosettes and enclose it in colored borders. Among grisailles that one can regard as oldest are those that fill the windows with tracery in the apsidal chapel of the abbey church of S. Germer. The construction of that chapel followed slightly that of the S. Chapelle of the palace at Paris, i.e., it dates from the beginning of the second half of the 13<sup>th</sup> century. Built at one spurt, its grisaille glass dates from the epoch of its construction, and already shows borders, some strips and scattered rosettes in colors. In the example (Fig. 43) the border is composed of saffron yellow leaves on a blue ground with an internal red strip. The four lobes R are uniformly red. In the example (Fig. 44) the border consists of yellow fleurs-de-lis on a red ground without an inner colored strip, and the rosettes are formed of a green square enclosed by four red semicircles.<sup>1</sup> One will note that already in this grisaille the white strips are outlined by a lead on one side only, the other side being painted. This was a simplification of the procedure of the beginning of the 13<sup>th</sup> century, but the general effect loses the amplitude and firmness of those first grisailles. The grounds are always a very fine lattice made with the brush. Yet at the end of the 13<sup>th</sup> century, the strips of color become more numerous and the rosettes more important; the lattices of the ground are replaced by a quite unequal tone, a sort of glazing that has the inconvenience of coloring those bistre grounds, that takes from the delicacy of the grisailles. Among the most beautiful grisailles of that epoch, or of the beginning of the 14<sup>th</sup> century, it is necessary to cite those of the cathedral of Narbonne. Here (Figs. 45, 46) are two of those varied panels. In the first the border is composed of painted yellow squares J, between which are placed a blue and a red glass, B, R. For the body of the grisaille the rectangular strips are blue, the curved strips are red, the rosettes have yellow hearts, the circular trefoil is red and the angular trefoil is green, or the reverse. On the white glass, the painted ornament leaves between it and the colored strips a margin without grisaille, which very skillfully enhances the red and blue tones of the interlacings. The





drawing of this glass is to be mentioned. The width of the panel A X between the borders was divided into 6 parts. From each of those dividing points were drawn lines at  $45^{\circ}$ ; the centres of the curves, the curved as well as the straight strips, are found on that third diagonal. Thus the centres of the curves a b a r e found at the points c, etc. It is unnecessary to say, that a white strip encloses the border on the outside. In the second example (Fig. 46), the colors occupy a great part of the surface. The border consists of yellow fleurs-de-lis on a blue ground; then is placed in internal red strip. the shields of arms are of argent and the cross of gules; or parted in half; the first of argent with pattee cross of gules and or, charged by a tower of sable; the second of or with red stripes. Other shields decorate this glass; the first is detached on pearly yellow ground enclosed by two square crosses of vert and purple violet; the second is placed on a blue ground with squares of the same below, but with alternating tones. The effect of this grisaille is very beautiful; if indeed one can give the name of grisaille to glass, where colors occupy more than half the surface.

Note 1.p.455. Our Figs. are at quarter full size. These drawings were furnished to us by M. Boeswilbold, who directed the restoration of the S. Chapelle of S. Germer.

The cathedral of S. Nazaire of Carcassonne also preserves very remarkable grisailles of the beginning of the 14 th century, where color fills a very important part. Particularly in the two north and south rose windows, these grisailles are actual colored mosaics.

About the middle of the 14 th century, when men came to apply yellow by means of the salts of silver, they sometimes enhanced white grisailles by yellow touches. One sees pretty grisailles of that kind in the chapel of Vendome of the cathedral of Chartres. The storerooms of S. Denis also possess a very pretty panel, that has been reproduced by M. A. Gerente. It must be stated that this kind of grisaille is better suited for the openings of apartments than for the windows of great naves. This decorative means is too meagre to produce a distant effect on great translucent surfaces.

In the 15 th century the fashion of tapestry grisailles was lost and was replaced by sketches of architecture in which the yellow, with some colored figures of mediocre effect.





The 16 th century made many grisailles, or rather reliefs with subjects and arabesques. We do not think it necessary to return to what we have said on this procedure of painting on glass.

It is known that the Cistercians did not admit in their churches paintings and sculptured figures. Deprived of those means of decoration, those religious closed the windows of their churches by means of white glass arranged so as to form rich designs by the lead settings. From the year 1842 we have noted glass of this kind dating from the first years of the 13 th century in the abbey church of Pontigny, that depended on the order of Cîteaux. Later in 1850 Abbe Texier mentioned glass of this kind in the churches of Banlieu and of Obazine, <sup>1</sup> both Cistercian. This uncolored glass dates from the 12 th century. The designs of the glass of the church of Banlieu is perhaps some years earlier than that of the church of Obazine, but otherwise the system adopted is the same in both monuments. These designs are well composed, broad and of a beautiful character. One can judge of them by the example that we give here (Fig. 47), taken from the church of Bonlieu. On some points, remarks Abbe Texier, the leads do not enclose the glass, but are attached at only one side. <sup>1</sup> It was there only to complete the design and to avoid too difficult cutting. Besides, this is an expedient rarely employed.

Note 1.p.258. *Annales archéologiques*. Vol. X. p. 81 et seq.

Note 1.p.459. The non-enclosing leads are marked by a white line.

M. Ame has drawn a part of the white glass of the Cistercian church of Pontigny. Some of these glass windows nearly approach in design those of Obazine, but others differ essentially from them and present partly combinations of straight lines. Here (Fig. 48) is one of those panels whose arrangement recalls that of the beautiful grisailles of the beginning of the 13 th century. <sup>2</sup> Once on that path, M. E. Ame discovered glass of this kind in a certain number of edifices of the department of Yonne, particularly in the churches of Mesennes, of Chablis, and in the chapel of the old hospital of Sens. We likewise in 1842 drew some in the little church of Montreal, which date from a much later epoch, the 15 th or 16 th century.

Note 2.p.459. *Recherches sur les anciens vitraux incolores du département de l'Yonne*, by M. E. Ame (Didron). 1854.





This system of glazing then was not only employed by the Cistercians, since the last edifices did not depend on that order. However, it must have been adopted when resources were lacking to execute colored glass or painted grisailles. Since our attention was directed to this sort of glazing, we have discovered many fragments in churches of the 13<sup>th</sup>, 14<sup>th</sup>, 15<sup>th</sup> and 16<sup>th</sup> centuries; fragments that present infinite combinations. One still saw entire and varied panels of it in 1843 in the abbey church of Beaulieu near S. Antonin, that dated from the end of the 13<sup>th</sup> century, and which then belonged to a farm. Here (Fig. 49) is one of those panels of an original design. The glass of these windows is not of a uniform white transparency, but is of unequal thickness, and is more or less greenish or yellowish, which adds to the effect of this sort of glazing. The setting in leads of this last example is very careful. In the upper part of our Fig. is indicated the mode of drawing, and the means of finding the centres of the quadrants composing the compartment.

It is not to be doubted that the glazing of the windows of habitations was composed thus in most cases, since the vignettes of manuscripts always show us white glass set in leads in varied compartments in the interiors of apartments. Frequently a heraldic shield figured at the middle of these white panels, in the glass windows of castles and palaces, or a device or emblem, giving some points of color to enliven the white surface of the great windows, without reducing the light necessary in every room serving for habitation.

Painting on glass certainly requires a very lengthy treatment, if one wished to make a complete history of it, and to indicate the different procedures employed by the various French schools, during the space of three or four centuries. In that study of this art or of this industry, if one prefers, recently renewed by some distinguished artists, there is a very extensive field of observation to be passed over. We can only indicate the salient points of this study and remain within the limits of the dictionnaire. Perhaps some will even find that we have extended at too great length on one of the parts of architectural decoration; but it seems to us that in that art of translucent decoration, there are resources that could be utilized in a wider manner, than is done in our days. In a climate like ours, where





the light of the sun is often veiled, where the interiors of edifices and of habitations are only lighted by a dull light, it would be natural to seek to color that pale light. There would be the feeling of the colorist. We have allowed this feeling to be stifled under a classicism of narrow views, pretentious in its expressions, which does not demand that one should understand, but should admire confidently what it allows in art. Certainly, a long experience and serious studies are necessary to recover the neglected traces of this industry of the glass painter.

Some devoted men have made considerable efforts and sacrifices in our days to recover those traces. They have even opened for our country a source of very rich production; but being badly seconded by glass manufacturers, who do not occupy themselves with the conditions essential to translucent coloring; obliged to struggle against a competition of cheap products, that depreciate this beautiful art in the eyes of men of taste; systematically repulsed from the great public works by powerful groups, it is with great difficulty that they keep their shops open. However, they are not discouraged; their industry must find a good place in a time when architecture tends more and more to erect vast and well lighted edifices; but they should use the leisure given them by a systematic opposition to know the true resources of this decorative art in particular. When the day of reaction against academic mediocrity arrives, they will be ready.

#### VOIRIE. Public Streets and Ways.

Under the feudal regime, the roads and ways belonged to the lord on whose land were opened these public ways. The lord had the right of changing the direction of those ways and of receiving the tolls intended for their maintenance. In the cities the public streets belonged either to the municipality, the sovereign, or to the lord possessing the feudal rights.

At Paris before the 13<sup>th</sup> century, the public streets belonged only to the king and the bishop within his jurisdiction. Only after the reign of Philip August the control of the public streets passed into the hands of the provost.

In most cities of Languedoc, which had retained nearly intact their Roman municipal forms, the rule of the public streets be-





belonged to the consuls, who then policed the streets and places. Frequently the policing of the streets belonged in common to two powers in the same city. This policing consisted in preventing the making of cellars beneath the streets, the establishment of broad flights of steps that might obstruct passage, projections of hoods injuring passers or neighbors, and the deposit of sewage there. Inspectors looked after the maintenance of the paving and the discharge of water, the repair of common wells and fountains, and the maintenance of chains. One will understand how the control of the public streets was often divide among several lords in the same locality, and was the occasion of numerous conflicts. The *Olim* indeed contains a good number of decrees made concerning those disputes. We give here one of those decrees dating from 1312, which clearly explains the nature of the conflicts and how they were decided by the king's court. (Old French text). <sup>1</sup>

Note 1.p.464. The *Olim*, published by count Beugnot. Vol. II. p. 561. Collection of unpublished documents on the history of France. Series I.

It results from the tenor of this decree, that in spite of the claims of the abbot of S. Riquier to possess feudal rights over the city, the inhabitants could repair the houses on the public streets and places of the said city, on warning the inspector of the abbey, except in case of a major force, such as the ruin of a wall, of a house, <sup>2</sup> or the curb of a well, in which case the inhabitants could proceed at once to rebuild without preliminary notice. In any case the notice given to the inspector is useless, when it concerned repairing the defenses of the city. Thus the royal power, without entirely destroying the rights of the feudal lords, actually annulled them by limiting these rights to a simple declaration made to the feudal inspector, a declaration that could not be followed by opposition to the declared repairs. As for the walls of the city, regarded by the sovereign as belonging to him, if he had need to repair them, it was not even necessary to notify the inspector of the lord possessing feudal rights over the lands of the city. Only gradually the royal power thus succeeded in taking possession of the control of public roads and the streets of cities, and the ordinances of the kings of France after the 13<sup>th</sup> century are full of decisions, that tend to centralize questions of





public roads in the hands of the sovereign. Before that epoch the post of inspector is created in the cities made communes by the lord granting the charter. For example, at Auxerre in 1194 the charter of the count of Nevers, who instituted the commune, created the post of inspector and fixed his jurisdiction.<sup>2</sup> All the disputes referred to the king's court generally produced a decree, that might be regarded as an infringement by the sovereign of the feudal rights or those of the communes.

Note 2.p.464. Boluze, Miscell. VII. 326.

VOLET. Shutter. Blind.

A solid wooden shutter of a window, placed inside or outside. (Art. Menuiserie).

VOUSSOIR. Voussoir. (Art. Claveau).

VOUSSURE. Arch. Archivolt.

Rows of voussoirs of archivolts that enclose the tympanum of a doorway. (Art. Porte). The name of cavetto is also given today to the curved surfaces forming the transition between the walls of a hall and the ceiling; but this kind of construction was not adopted during the middle ages; it only dates from the end of the 16<sup>th</sup> century.

VOUTE. Vault.

In Art. Construction we have explained in a general manner, how from the system adopted by the Romans for vaulting their edifices, the architects of the middle ages had arrived at entirely novel combinations of vaults lending themselves to all plans. We do not here have to return to what that Article contains, to the means employed to resist the thrust of vaults, but to develop the various procedures adopted in France from the 11<sup>th</sup> to the 16<sup>th</sup> centuries for drawing these vaults, and establishing them on their supports.

At first one fact must fix the attention of the observer, that examines the vaults constructed by the Romans under the empire; this is the economy applied in the construction of those vaults. However great builders they were, the Romans brought into their works principles of economy, that we cannot meditate on too much. Now since it here concerns vaults, no one is ignorant that





the causes of perhaps the most important expenses in the construction of vaults are the wooden centerings, that are necessary to support them till the moment when they are closed, and when they can support themselves by the complete juxtaposition of the materials composing them. When one examines some of those great vaulted Roman edifices, like the Baths of Antonine Caracalla, of Diocletian, the basilica of Constantine at Rome, etc., one is at first disposed to believe, that there was necessary an enormous volume of wood for forming those vast concrete structures, centerings of prodigious strength; consequently considerable lost preliminary expenses. Yet a more careful study of these vaults soon causes it to be recognized, that on the contrary, those constructors being practical first of all, knew how to enclose those enormous concrete structures by the aid of economical and very simple means. If one takes the trouble to analyze these wide Roman tunnel and cross vaults, and domes, he finds that these curved surfaces, apparently uniform and homogeneous, are formed of a series of ribs and even cells of bricks, whose intervals are filled by a concrete composed of light stones and mortar. Thus to close a very large vault, it sufficed to place a certain number of carpentry centres, relatively limited and of moderate strength, and to connect them by a plank form on which the vault was constructed, as we shall see.

It even occurred, that not to place on the light carpentry centres a pressure that they could not resist, the constructors formed the principal ribs of rows of bricks superposed, the first serving as a permanent centering for those succeeding and thus relieving the temporary carpentry centering. The constructor even frequently turned on centres quite far apart and only connected by planks, a vault of large bricks laid flat, a vault that had but in insignificant weight, and on that vault or light shell, already very resistant, he formed the principal ribs and the cells of bricks, filling the intervals with concrete.

Our Fig. 1 will explain this method of constructing vaults. Let a tunnel vault be erected. Light centres of carpentry A are raised and set at equal distances, their curves commencing at the level of the part of the vault already erected without the aid of centering, but by the help of a simple wooden radius rod or of curves. These centres are connected by planks or





lagging B, that it is not necessary to lay close, planks sufficiently thick as not to bend under the weight of a man. On these planks the masons have laid the covering C of great flat (square) bricks, just as are built in our days vaults of tiles or square slabs of terra cotta, cement or plaster.<sup>1</sup> Henceforth the workmen operate on a solid shell, homogeneous and able to resist a load. The ribs D are set over each centre and are made of great square bricks. These ribs have been arranged as indicated by the detail X with double bricks a b at certain distances, so as to be able to set in the groove between them planks P normal to the curve. On these planks regarded as supports, have been set the purlins E with great bricks with broken joints. After the setting of the mortar holding the bricks of these purlins, the planks are removed, and then the empty cells remaining were filled with a concrete of tufa or pumice stone and mortar. It is evident that if from the level N the masons had turned a vault of 15.7 to 19.7 ins. thick in bricks or rubble by the ordinary procedure, i.e., by gradually carrying up the rows of voussoirs from this level N of the crown, very strong centres of carpentry and lagging would have been necessary; for having reached the level M of the vault, the pressure of the structure on the centering would have been very considerable, and as great on the lagging as on the centres themselves. Further the carpentry centres shrink and always yield a little in their connections, retaining their curvature for several weeks with difficulty, if they are cut for a great diameter. The shell C must be set very rapidly, and of itself forms a centering, and the carpentry centres under this shell could dry and be deformed without inconvenience. They were longer kept in place with their centering, only as an excess of precaution. There are still seen traces of this tiling, single or double, in many Roman vaults.<sup>2</sup> It received the internal coatings that adhered to its surface by ceans of joints of plaster or mortar, that connected the bricks laid flat. If the vault was a cross vault, the system employed was the same, and the diagonal arches marked the intersections of the half cylinders. Those diagonal arches (Fig. 2), could not be set at the same time in the two curved surfaces, which have a right angle only at the springing of the groin. In fact when two half cylinders intersect at a right angle, it is known that the angle of the junction of the





curves becomes more obtuse as one approaches the top or crown of the vault. A brick arch cannot be moulded in that form, since there would be required as many different angles as there were bricks in one branch of the arch. The Roman constructors then set the diagonal carpentry centres according to the true line of intersection, then placing on the curve of the centres wooden forms *b* (see *A*), leaving at certain distances between them intervals *c* and of less depth as they approached the top of the arch. On these forms the mason then set the diagonal arch perpendicular to the diagonal plane (see *B*). The section of this arch is represented by the square *e f g h*, the forms filling the space *i j*, and the centre being *k*. In the intervals *c* were set double cut bricks, as indicated by the trapezoids *o p q r*, their edges according to the horizontal direction of the two cylinders. Thus are obtained the construction indicated at *E*. Two rows of bricks parallel to the surfaces of the vaults permitted placing at *l* the planks (as shown in the preceding example), which allowed the setting of the purlins *m* in which was placed the concrete filling. The projections of bricks spread parallel to the surfaces of the vaults served to trace and preserve the groin, made at the same time as the plastering. If this concerned a dome, where these brick ribs formed arches engaged in a portion of a sphere, as one can see in the vault of the so-called temple of Minerva Medica at Rome, where these ribs form a series of imbricated arches, as in the vault of the little round hall of the Baths of Diocletian.

Note 1.p.467. Plaster was employed by the Romans in the circumstances indicated here, notably at the theatre of Taormina in Sicily, and in the Baths of Antonine Caracalla at Rome.

Note 2.p.467. Notably on the vaults of the Baths of Antonine Caracalla.

This construction of vaults then presented the following advantages:— 1, economy of centering; 2, rapidity of execution, yet without having to fear accidents resulting from momentary interruption of the work; 3, facility in employing workmen of different qualities; for to fill the cells with concrete only required laborers; 4, the possibility of removing the centering immediately after filling the cells, and even before that filling, if one had to employ the centering elsewhere, since the shell composed of bricks laid flat more than sufficed to





5, elasticity during the duration of the work, which allowed the avoidance of ruptures, that manifested themselves in a structure absolutely homogeneous, and that required a certain time for completion; 6, after filling the groins, a perfect connection. In the construction of very large vaults, that even by their extent could not be closed in a brief space of time, there frequently appeared ruptures during the work or immediately after its completion. Those accidents occurred during the construction of the dome of S. Sophia of Constantinople in such a serious manner, that it was necessary to commence the work again; but the Romans of the late time no longer knew how to build like their ancestors. After the construction of the dome of S. Peter of Rome appeared cracks. It is easy to conceive when curved surfaces of that extent, built slowly, after the completion of the work, present parts perfectly dry and set, others being still soft, so to speak, or at least slightly compressible. To that inequality in the setting of mortar, and consequently in the compressibility of these surfaces, must be attributed the disorders found in the great masonry vaults erected since the good epochs of the empire. But if instead of erecting those vaults in courses and by zones, as still done in our days, a skeleton were rapidly built in accordance with the form of the vault itself and its curvature, which is easy, one could take all the time necessary to fill the intervals left in that skeleton; for that being established the vault is built, it takes its equilibrium, suffers settlements without stress or rupture. This method must very naturally lead Roman constructors to adopt caissons for their vaults, particularly for spherical vaults. Let us see why. To build a spherical vault, it is necessary to establish radiating centres dividing the sphere by arcs, just as degrees of longitude divide the earth; but since the lagging from one centre to another produces straight lines, it resulted either that the vault was composed of a series of planes, or that it was necessary to build a form on this lagging to arrive at the spherical curve. That required much wood, was lengthy and consequently was expensive. More serious difficulties arose of the spherical vault had a very great diameter, like that of the Pantheon at Rome, for example. <sup>1</sup> Assuming that one desired to erect a vault covering as great an area by the method adopted in mod-





modern times, i.e., by zones of masonry successively built on centerings, one understands what strength it would be necessary to give to those centres, and how it would have been essential to ensure their perfect immobility during a very considerable time; now the wood shrinks in such great volume, and considering the number of its connections, is deformed, so that in spite of all precautions, a centering of this importance would perhaps sink at its top 20 ins. at the end of 3 or 4 months. So much is not necessary to compromise the erection of the dome of that dimensions. But if on a relatively light centering, the constructors could in very little time erect a light skeleton, yet sufficiently resistant to allow the completion of the construction of an enormous hemisphere, without haste and without fearing settlements or partial deflections, the problem would be solved, and one would run no risk, for the removal of the centering of the vault would be reduced to the removal of wooden timbers, whose functions had become insignificant; this could be done without taking very careful precautions, without which a catastrophe might occur. In structures it should never be forgotten that the lack of precaution or of skill could not occasion a disaster; the practical procedures must offer all security, and nothing should be left to hazard or to a more or less happy chance. In that manner evidently, the Roman architects understood how to erect their structures.

Note 1.p.470. The vault of the Pantheon of Agrippa is 142.26 ft. in diameter.

Piranesi has given an engraving of the construction of the dome of the Pantheon of Rome; but we do not know on what basis he made that place, for in his time, no more than today, could one accurately recognize the construction. We think that the system that he indicates as that of the extrados of the dome, that he might have seen when the lead covering was repaired; he would have assumed that the combination visible on the exterior must be reproduced in the interior; now that is not possible, if one considers the arrangement of this interior and the thickness of the vault, which is not less than 4.92 ft. near the lunette. The bricks that one can see on the extrados certainly do not extend through the thickness of the vault; then the structure, the visible framework in the interior can be different from that visible on the exterior. We will go farther, and





will say that those two skeletons must be absolutely different, and we shall explain why. When the Romans built a transverse arch, the head of a tunnel vault supporting a load, or even a relieving arch, they took care to proceed as indicated by Fig. 3 at A; they laid up from the springing about a quarter of the arch in rows of bonded bricks; then the two quarters remaining in rowlock brick arches. Since they built the relieving arches before the fillings that these arches were required to relieve, centres were necessary for those arches. The system of rowlock arches allowed them to not load beyond measure the carpentry centre at its weakest point, since they commenced by setting the first row of voussoirs D E. This row being set, the centre had nothing more to bear, and they could turn the other two arches. Yet if the Roman constructors had only the intention not to load the carpentry centre from the moment that the first arch had been turned, they would have built the rest of the arch with bonded bricks, using the first arch as a quite sufficiently resisting centre; but on the contrary, we see without exception the upper part of the transverse or relieving arches are built in rows of rowlock bricks. This method was justified by experience. If we assume the arch A (relieving arch of the external wall of the Pantheon of Rome) built entirely of banded bricks, as sketched at B, and that the piers F and G spread apart because of some movement, for example an earthquake or settlement, this arch will break in the extrados at H and at I in the intrados; all the pressures will then act on the two angles K and the corner L, and if the load be great, these will crack, so that the segment K K will no longer support it. But if this relieving arch had been constructed like those of the Pantheon (see A), and the spreading of the piers had occurred (see C), the three rowlock arches would bend and open, and the loads would be divided between 6 angles of the intrados at M and 3 angles of the extrados at N, at the crown. The angles of the ruptures would be shorter, and the disorder would be much less than in example B. One then understands why these brick arches are always rowlock arches in their upper part, i.e., in the part bearing the load; this was to retain a certain elasticity, that arches homogeneous in their depth could not have. This principle is based on observation, so simple also, but so little followed in modern architecture, for a stronger reason, was





applied to domes of great diameter.

Conformably to the method explained in Fig. 1 and by reasons given above, it was necessary for a dome like that of the Pantheon to be rapidly blocked out on the centering, so to speak, that the Romans adhered to making light and short timbers as much as possible, in order to avoid useless expenses, difficulties in setting, and the waste of carpentry. To clearly explain the method of the Roman constructors, when they desired to erect great domes, we will take as a type the Pantheon of Rome. Fig. 4 presents a section of that hemispherical vault. The external wall with its relieving chambers so skilfully combined, has been built up to the level N with the beginning of the vault, divided by 28 coffers in its circumference, leaving between them 28 solid piers, that lose themselves in the solid portion of the calotte comprised between the point a and the eye L. These 28 piers indicate the places of the carpentry centres C abutting against a frame of carpentry composed of 28 p posts and two strong rings. We assume these centres to be made of short timbers and according to the system of Roman carpentry reproduced in the reliefs of the column of Trajan. Except by means of a prodigious expense, one could not think of placing centres resting on the ground and with ties. This system of centering is further still used at Rome and a part of Italy and is solid, but cannot support a very heavy load. The 28 half transverse centres being set, it was necessary to connect them by cross timbers and to form the centering to receive a masonry vault. If the constructors had claimed to close in this carpentry a calotte like that with the given section, it is evident that the centering would have been deformed by the load as soon as the masons reached the point P, for on such a great surface it was not possible to construct at the same time an entire zone of the dome. Certain points would be accidentally loaded more than others, from which could result immediate disorder. One sees at A one eighth of the horizontal plan of this system of centering. In section the coffers are so profiled that their edges are all visible from the centre of the pavement of the edifice; i.e., (see at R the detail of the section of one of the coffers of the second zone), the eye of the observer being placed at the centre of the edifice on the pavement perceived the entire depths of those edges, which tend to





this point of sight. The centering being thus arranged, it was necessary to find the quickest and most economical method for building that enormous dome. The details of that operation are explained in Fig. 5. At A are the centres. To connect the curves and to place purlins, ties a have been nailed on the sides, as one would do for lintels. These ties each had two gains that received the purlins E, that were notched at e to receive the additional centres G. Sheathing P rested in a rebate and connected the two purlins. There remain the open frames F to be closed. Now the skeleton of the carpentry so combined being perfectly stable and as light as possible, indicates the work incumbent on the masons. They profited by the wooden members for setting their brick ribs; it was useless to fill the spaces between the ribs with solid masonry. On the contrary, this was a case to profit by these spaces F left between the members to lighten this masonry. Then instead of closing those voids by ordinary lagging on the frame composed of purlins and extra curves, they placed another projecting frame g, on which was a second projecting frame h, and a third i, then a panel of planks, each being smaller. In section these three frames and the panel gave the profile indicated at R in Fig. 4; thus they found the mould for the coffer indicated on the centering. The masons could then execute their work very rapidly, as indicated by the sketch B in Fig. 5. They turned on the centres the brick ribs G, connected at the purlins by the brick shores H, also slightly curved and set on a wooden centre removed as soon as the arch was turned. This brick skeleton repeated accurately the wooden framework, leaving the coffers visible, on which it was only necessary to place a concrete of light materials and mortar (see at S). It is clear that the panels M of this concrete were much thinner than the depth on the framework. This concrete in cells then formed as many little compartments comprised between the longitudinal ribs and the zonal bands of brick. This first operation could be rapidly completed and formed a very resistant shell, well balanced but light, and that thenceforth made the wooden centering superfluous. That might dry and open in its joints without resulting in the least disorder. But a hemispherical vault of this extent and about 1.6 ft. thick at the ribs could not offer serious guarantees of durability for constructors, that claimed to leave nothing to the chances of accident,





such as a hurricane, a great atmospheric pressure, an oscillation of the ground (from which Rome was not exempt). It was necessary for this framework of relatively thin ribs to be preserved, enclosed and held by a protecting shell. The hemispherical calotte being made even externally by concrete, or rather by coarse plastering, the constructors sought the means most suitable for ensuring this light and fragile shell. Thus they must have adopted the system seen by Piranesi, a system explained in Fig. 6. Of all the great domes known and still entire, that of the Pantheon of Agrippa is the only one not cracked. That of S. Sophia was restored on several occasions; that of S. Peter of Rome is cracked in a very serious manner. <sup>1</sup> Then we believe it is due to this double system, that the dome of the Pantheon of Rome must be preserved intact, in spite of terrestrial movements, that on several occasions caused accidents to certain edifices of this city. We have not been able to verify the fact of this framework of arches doubling the dome with coffer; the indications of Piranesi can alone supply information. But certain arrangements of the drum of the edifice leaves little doubt to us in that respect. In fact if one glances at Fig. 4, he sees that this drum (see the eighth of the plan at A) presents a series of solid and void parts, that coincide with the points of support of the lower niches forming chapels today. Knowing that the Romans in their structures do nothing without a motive, one could not understand why the buttresses T were reserved, unless they contributed in some efficient way to support the dome. These buttresses T are not arranged at the ribs of the coffer; they have a distinct function, explained by the outer framework represented in Fig. 6. To form this the dome with coffer served as a centering, and light centres of wood sufficed for turning the arches resting on the extrados of that dome. After these arches were turned, it only remained to fill the intervals with a concrete of light materials, as indicated at B in Fig. 6.

Note 1. p. 478. It is necessary to state that these two domes are erected on pendentives; but the nature of the cracks produced in the dome of S. Peter does not indicate that these disorders are only due to settlements. There are ruptures in the dome itself caused by a slight elevation of the zone of the haunches of the dome. The ruptures produced by settlements, on the cont-





contrary, are produced (and that must be so) at the base itself of the hemisphere, which is the motive for placing a circle of iron at that base; these cracks are according to the meridian lines. The cracks seen on the extrados of the zone below the lantern are according to the horizontal circles, and produce a pressure on the intrados, that causes the separation of pieces of plastering and of mosaics.

The economy of centering occupied the Roman constructors so much, that even when they made vaults of cut stone and of sufficiently great size (which is rare), as for example in the monument of Nîmes known under the name of baths of Diana, they set transverse arches on centres, and those transverse arches themselves served as centres for setting great slabs on them as one places lagging. Our Fig. 7 explains that system of construction of vaults. In this last case, the constructors saved all wooden centering, since the thick slabs of stone have each end resting on the transverse arches. Then it is evident, that in the construction of their vaults the Romans economized as much as they could, both material and time, and consequently never incurred useless expenses. One can scarcely cite one or two examples of cross vaults with cut sections in all the edifices of antique Rome. By this same motive of economy they avoided penetrations, back-arches, masonry pendentives, and which our modern architects show them so lavishly, when they claim to have studied antique architecture to derive benefit from it, to the great damage of our finances. <sup>1</sup>

Note 1.p.477. M. Choisy, a young French engineer will soon publish a very complete work on the structure of Roman vaults, from the monuments. This collection, that we have had in our hands, gives in detail the various procedures employed by the great constructors, and demonstrates in the most evident manner, that economy in expenditure was one of their principal cares. We advise architects that seriously desire to know the procedures employed by the Romans in construction, to refer to the works of M. Choisy on this matter.

We must extend a little on the system of construction of Roman vaults to show certain analogies between this system and that adopted in France about the middle of the 12<sup>th</sup> century. Analogies in principles, as will be seen, and not in forms; which proves again that true principles established on correct





and logical observation, are not a restraint in the art of architecture, but on the contrary is the sole producing force.

Already at the end of the empire, these methods employed in the construction of vaults were changed; the constructors neglected the opportunity to regularly apply the procedures accepted in Roman edifices until the Antonines. At Byzantium the great vaults of the church of S. Sophia are rudely constructed. It is unnecessary to state that during the first centuries of the middle ages, the last traces of those traditions of the good Roman epoch were effaced. Men sought to reproduce in small dimensions the visible forms of Roman vaults, but no longer knew their actual construction. It was only at the beginning of the 12<sup>th</sup> century, that a sudden advance in the construction of vaults manifested itself, and there appeared the embryo of a new system in the West. This phenomenon occurring at the moment of the first crusades, it was very natural to attribute this abrupt development to oriental influence; but the documents that could be collected up to the last years scarcely confirmed these assumed conjectures, when count Melchior de Vogue undertook a journey in central Syria. Accompanied by a young architect, a skilful draftsman, M. Duthoit, count de Vogue brought from those provinces a mass of documents of high importance for the history of our French art, for they give us the explanation of the progress, that manifested itself so rapidly in the West from the first years of the 12<sup>th</sup> century.<sup>1</sup> In fact these monuments of central Syria due to a Greco-Roman civilization present a special character. In their construction the Greek and Roman elements are not placed beside each other, as it occurred in the edifices of imperial Rome; they combine under the clear and logical mind of the Greek. We have emphasized many times this singular arrangement of the Roman architecture of the empire,<sup>1</sup> which only regarded Greek art as a sort of decoration independent of the structure; so much so that in every Roman edifice, one could remove that ornamentation borrowed from Greek art without affecting the organism, so to speak, of Roman architecture.

Note 1.p.479. See *Syrie centrale; civil and religious architecture from 1<sup>st</sup> to 7<sup>th</sup> centuries*, by count Melchior de Vogue. Baudry. publisher.

Note 1.p.480. See *Entretiens sur l'architecture*.





The Greco-Roman edifices of central Syria proceed quite differently; the two Greek and Roman constructions lend a mutual assistance; there is no longer a skeleton and the vestment covering it, but a body complete in all its parts. The arch and the lintel are no longer combined in spite of their properties, as seen so frequently in the architecture of the empire, but fulfil their actual functions. This rationalism in the art evidently exerted an influence on the western peoples, who threw themselves in compact masse into those provinces at the end of the 11<sup>th</sup> century. It was no longer to follow afar the weakened traditions of imperial art; the crusaders found in the cities already abandoned but still standing in the Hauran, an architecture new to them, clear in its expressions as a lesson well learned, fertile in deductions, easy to understand, and that could be adopted to every need.

The cross vault does not exist in those edifices, all being built of jointed masonry, but indeed only the tunnel vault, the dome and half dome. Transverse and archivolts are frequent, and these transverse arches that form bays support either ceilings of stone or of carpentry, according as the localities have or do not possess wood.

We shall examine why these arrangements must have had a direct influence on the construction of our western vaults, and caused the abandoning of the mode of construction of the Romans. Here (Fig. 8) is a fragment of the basilica of Chagga,<sup>2</sup> whose erection dates from the 3<sup>rd</sup> or 4<sup>th</sup> century of our era. The bays of this basilica are narrow (8.2 ft. on centres of piers) and are covered by thick slabs between the transverse arches; a layer of tamped earth covered with a coating formed the tight terrace on the upper slabs. The construction consists of piers of square section bearing transverse arches over the principal nave, abutted by other transverse arches turned over the side aisles, which sustain a gallery in the second story looking into that central nave. The character peculiar to this construction are the transverse arches composing the internal skeleton of the edifice. Nothing similar in the western Roman structures of the empire. The Roman vault of masonry as just shown at the beginning of this Article, rarely possesses visible transverse arches,<sup>1</sup> since these arches are imbedded in the thickness of the vault itself and are only concealed ribs.





Note 2.p.480. See Syrie centrale.

Note 1.p.481. The example of the temple of Diana at Nîmes is an exception. It must not be lost from view, that the Roman monuments erected in Provence are permeated by the Greek spirit, far more than those of Italy, particularly in approaching Marseilles. It is interesting to verify the analogies existing between those antique monuments and of Roman Provence and those of central Syria.

For western architecture, so greatly impeded at that epoch, when they attempted to establish vaults on the plan of the Roman basilica (Art. Architecture religieuse), the sight of an edifice like the basilica of Chagga, -- central Syria still possesses several conformed to these arrangements, -- must bring forth the idea of applying this mode of construction, while replacing the terraces, suitable neither to the climates of the West nor to the nature of the materials at their disposal, by a tunnel vault over the middle aisle, by cross vaults over the side aisles, and by a half tunnel vault over the gallery to permit the establishment of inclined roofs and to abut the central tunnel vault. These deductions naturally presented themselves to the minds of the western constructors, however unsophisticated they may be supposed.

The section of the basilica at Chagga (Fig. 9) gives the sketch A; two bays of the plan are projected at a. Subjected to the necessity of covering their edifices by slopes sufficiently steep to receive tiles, and not being able consequently to employ the system of terraces of the Syrian architects, the western artists desiring to apply the very simple principle of those basilicas, only had to raise the great transverse arches of the nave, as indicated at C in section B, to connect these transverse arches by a tunnel vault concentric with their extrados, to turn a half tunnel vault D over the gallery between the transverse arches E, and according to the Byzantine mode,<sup>1</sup> cross vaults between the lower transverse arches of the side aisles. The substitution of vaults for terraces necessarily forced the piers P apart. The archivolts F and other archivolts I, or an opening looking into the central tunnel vault. But the archivolt G intended to receive the vaults of the side aisles advanced to the inner faces of the piers P, and then to support the upper transverse arches C, it was necessary to add to these





piers a projection L in the form of an engaged column. From a structure in which the arch and the lintel were simultaneously employed with an exquisite feeling of truth, the western architects without too much trouble came to build a monument entirely vaulted. Still this modification, apparently so simple, raised difficulties in detail, that were only gradually solved. Yet such is the power of clear and logical primary instruction, that all labor involved was done under that primary influence. The western instructors, in seeing that Greek architecture of Syria, learned to reason; thus from that epoch their works, previously so confused and full of traditions badly understood, reproducing and corrupting more and more the forms of Roman antiquity, arose and advanced by relying on reasoning, in these principles left by the last of the Greeks.

Note 1. p. 483. We shall soon explain in what consists this mode.

This section B is that of most of our Romanesque churches built at the beginning of the 12th century in Auvergne, Languedoc, Provence and Lyonnais. One can easily verify that there is less difference between section A and section B, than between any vaulted monument of Rome and that section B. This round transverse arch E of the gallery, that one finds again in the galleries of the Romanesque basilicas of Auvergne and of Languedoc, and cannot be explained with the half tunnel vault (Art. Triforium), is a vestige remaining from that influence of the Syrian monument. As for the differences in detail just mentioned, let us first see in what they consist. The piers of the basilica of Chagga (see at a) are square in section, which was natural, since those piers only received two transverse arches, and that the archivolt connecting those piers starts as a penetration above the springing of the two transverse arches (Fig. 8). But we see that already in section B the archivolts G that connect the piers have their springings at the level of the springings of the transverse arches F (Fig. 9). The extrados of these archivolts G is only disengaged above that impost, and consequently the springing of the cross vault could only be established on a point raised above that separation, which is indicated in the perspective sketch (Fig. 10). There is an embarrassment, one of those difficulties in detail in the art of construction, that soon compels him to find a satisfactory solution, however little he reasons; now all those who have practised that art,





and who are not satisfied with almost right, who desire to find the true solution, know how these sections lead one to modify certain forms, that seem consecrated by time. And it is precisely in the manner of solving these difficulties dating from the first years of the 12 th century, that one recognizes the power of that logical instruction, found in the Orient by our French masters of that epoch. At first those masters reasoned thus:-- since two transverse arches and two archivolts spring from the same level, and that between those transverse arches and archivolts (on their extrados) it is necessary to start cross vaults, it is absolutely necessary for the pier to have exactly the sections of the voussoirs of those arches, so that they find their places on it, and consequently the square section does not suit that pier; then they draw the pier H (Fig. 9). Thus the transverse arches find their bearing at d, the archivolts at b, and the groins of the vaults spring in the reentrant angles e, that are the points of the intersection of the extradoses of those arches. But soon, when the vaulted monuments became greater, these architects recognized that the archivolts supported the side walls of the tunnel vault, and must have greater thickness than the transverse arches that are not loaded, that these springings of cross vaults in the angles require either a special jointing, or reduce the pier by reducing the load; then they draw the piers according to the plan K. The archivolts are separate at f, the transverse arches of the side aisle at q; the angles to receive the springings of the cross vault; the angles i, the relieving archivolts over the opening of the gallery, and the great transverse arch of the central tunnel vault, having the width m m, rests on the abacus a of a capital resting on an engaged column. But the archivolt f of the transverse arch g has a thickness greater than the space o p, from which it results that the groin h of the vault must rise vertically until the depth r p of the voussoirs is separated from the groin; then the constructors add also an engaged column to the front of the pilasters of the archivolts and to the rear transverse arch, so as to advance the voussoirs of these arches in a manner to disengage them entirely from their springing. Thus is gradually composed the Romanesque pier of the 12 th century, required by the deductions derived from the construction of vaults.





While men did not have under their eyes those monuments of central Syria, it was difficult for them to render an account of the motives, that caused the adoption during the last part of the Romanesque period, of these transverse arches separating the bays of vaulted edifices, since the Romans did not separate the bays of their vaults by transverse arches. The Syrian edifices give us the solution of that question. In those edifices, by a series of very correct reasoning, the transverse arches are made for spans too great to be covered by lintels, or by carpentry in a country where wood was rare for a long time; those arches support great terraces as in the preceding example, or purlins. This causes us to say that those Syrian artists knew better than the Romans, how to combine the arch and the lintel. Western architects have retained the transverse arches as the natural skeleton of every edifice built of stone; only between those arches they have turned vaults according to the Roman tradition, either tunnel or cross vaults.

But in S. Sophia at Byzantium, the Roman cross vault was already modified. Its central crown was then habitually placed above the level of the extrados of the crowns of the transverse arches (Fig. 11), if indeed one could give the name of transverse arches to arches scarcely projecting from the external surface of the vault. For example, the arch A of Fig. 11 was only the Roman brick rib, which instead of being entirely imbedded in the thickness of the vault, projected a little. One will further note that these arches A, B, C, are flush with the vault at its springing at D on the square abacuses of the capitals, and only emphasize their projection in approaching the crown. In brief, those arches are not concentric with the vault, which is a sort of compromise between the dome and the cross vault. Now this is the principle of construction generally adopted by our western architects in the construction of their cross vaults at the end of the 11 th century; according to this system were made the vaults of the nave of the abbey church of Vezelay, which date from the first years of the 12 th century, and not without reason was this method adopted. These swelled vaults offered more resistance than vaults generated by two cylinders intersecting at a right angle. We developed all concerning this question in Art. Construction, and it is not necessary to return to this subject here, the more because at the beginning of the





12 th century, men did not apply the care in the practice of building, that the Romans had known how to employ. They no longer made those fine large square bricks, that allowed the imbedding of strong ribs in the thickness of vaults and to obtain well bonded groins; built of tufa or of irregular rubble, very rarely of roughed rubble, the groins offered no cohesion and tended to separate. The more nearly the constructor approached the dome, the more he avoided the chances of rupture of the groins, since those scarcely formed a projection from the intrados of about half their depth, to lose themselves in an ellipsoid in approaching the crown. Besides, to trace the diagonal carpentry centerings, there was no need of seeking the curve of the intersection of the two cylinders, but it sufficed to draw a semicircle with a diameter equal to the diagonal of the parallelogram to be vaulted.<sup>1</sup> On these diagonal arches and on the extradoses of the transverse and side arches was placed the lagging, and then with earth was made the swelled form necessary for each triangle, so as to approach a dome more or less. They then built the masonry on this mould, without the necessity for making a special arrangement for the groins, only apparent at the springings and invisible at the crown. This sort of vault has the appearance internally presented in our Fig. 12, and the entire curved surface comprised between the points A, B, C, D, was either a spheroid if the vault was built on a square plan, or an ellipsoid if it was on a rectangular plan.

Note 1.p.487. All this theory is developed in Art. Construction.

But before entering into any developments of this subject, it is necessary to make known the experiments that preceded and produced the revolution, that occurred in the art of constructing vaults at the middle of the 12 th century.

We have stated that the Romans avoided as much as possible the penetration of tunnel vaults, as presenting difficulties and loss of time for the constructor. In fact the Romans, and this results from the study of their monuments, -- sought to economize time, i.e., while building so as to ensure perfect stability and a long duration for their structures, they claimed to obtain a result in the shortest time. Then they avoided the jointing of masonry requiring complex drawings and lengthy stonecutting. If they had a tunnel vault penetrating a vaulted hall, they kept the crown of this tunnel vault below the springing





of the tunnel vault must be penetrated. For example (Fig. 13), let a gallery A have a tunnel vault; the tunnel vault of the gallery B communicating with the former was turned, its crown C being below the springing of the tunnel vault D. The Coliseum at Rome, the amphitheatres at Arles and Nîmes, present that construction at every step. But again when the voussoirs are cut in stone, instead of being bonded and set side by side, as shown by our Fig. This system of jointing is visible, not only in the amphitheatres of Arles and of Nîmes, but also in the aqueduct Pont du Gard, and in many other edifices of the empire. It is clear that this method economized the time and cost; for there was only required a template for the stonecutters and at each joint a carpentry centre, instead of lagging on centres. In this case the setting proceeds much more rapidly, than when the joints of the voussoirs are bonded. The architects of the middle ages sometimes used this procedure, notably in Provence, where they had under their eyes examples of antiquity; but the plans that they adopted for certain parts of the edifices, like the side aisles surrounding the sanctuaries, side aisles into which chapels opened, required annular tunnel vaults intersected normally by other tunnel vaults. There was a real difficulty for the solution of which men could not resort to Roman structures, that do not present examples of this kind of vaults. The Byzantines had attempted to construct vaults resting on columns and forming intersections of cylinders, cones or ellipsoids; but it must be recognized that these attempts are rude, proceeding only by experiments, and do not give as a result a general method that can be formulated. In spite of the difficulties caused in the construction of the vaults of a side aisle extending around a sanctuary resting on columns, in starting from the Roman or Byzantine principle, it is to be believed that men strongly adhered to this arrangement of the plan, for western architects did not cease to seek the solution of this problem, from the beginning of the 12<sup>th</sup> century until it was completely solved at the end of that century. It must even be recognized that this long series of attempts in no small degree contributed to develop the system from which proceeds the cross vault of the 13<sup>th</sup> century; an excellent system, since it allows all imaginable combinations while always employing only the same procedure.





To cause to be appreciated the progressive advance in a work, that demands efforts of intelligence and the successive combinations of experience based on a positive science like geometry, there is nothing but to follow step by step the approximate and more or less happy solutions of the given problem, to show each improvement, the abandonment of certain methods that cannot lead to a definite solution. This is what we are going to attempt to do, in regard to these vaults extending around sanctuaries, passing successively through the combinations presenting themselves to the architects of the middle ages, from the starting point given to them, to the very complete solution of the problem set by themselves.

The Romans had turned cross vaults on isolated piers of square section, from the first times of the imperial period and perhaps under the republic, to cover cisterns and lower stories. These vaults had no transverse arches; they were half cylinders crossing at right angles in plan (Fig. 14).

When the Byzantines desired to vault circular galleries supported at one side on isolated columns, they turned archivolts from one column to another, and above the crowns of these archivolts they constructed an annular tunnel vault, or indeed an enclosing wall, and they erected a half tunnel vault that supported the line of crowns on the wall raised above the archivolts. Thus they avoided cross vaults, i.e., the penetrations of archivolts into annular tunnel vaults, and in that they followed the Roman tradition.

But this method of construction compelled the architects to lose a considerable height above the archivolts, and also to raise a structure, if they desired to find over these circular side aisles, either a gallery in the second story or windows. They one takes up at the end of the 11 th century in the West the method of causing the archivolts to penetrate the annular tunnel vault. Now in that case, see the difficulties that present themselves in a sanctuary supported on columns, (Fig. 15), or if the abacuses of the capitals are square as at A, the archivolts are wider at a b than at c d, or if they desire the soffits of the voussours of these archivolts to be parallel, the abacuses of the columns must be trapezoids in horizontal projection as at B. In the first case, these archivolts are portions of cones; in the second they are cylindrical; but if





curve of the sanctuary is not very large, these abacuses in trapezoidal form have an effect very disagreeable to the eye, and produce acute angles that badly resist a load. Seen diagonally, these capitals appear to project more at one side than the other, and seem to rest badly on the shafts (see D). Men t then attempted to adhere to the square abacuses; but instead of turning vaults normal to the curve of the sanctuary on a conical surface, their crowns were kept in a horizontal line, and the curve a b was an oval, while the curve c d was round; or indeed the springing of the archivolt was skew from a to c and b to d, so as to have at c d and a b a round-arched curve, and this last then gave the section of a tunnel vault that penetrated the annular tunnel vault.

Thus were constructed the vaults of the side aisle of the church of Notre Dame du Port at Clermont (Fig. 16). But, (see plan A) if one desired the arch a b, to be round, traced along the wall of the side aisle, the diameter a b being greater than the diameter c d and the diameter e f, the springing of the arch e f must be placed at a level much higher than that of the springing of the arch a b; so that an elevation made perpendicular to the axis X O would give the projection traced at B. -- Always assuming the crowns on a level --and that in a section made on O X one would obtain the projection traced at D, the springing of the archivolt they follows on the impost the dotted line g h. Vaults so conceived could not be rigorously drawn on the diagram; they were only obtained by experiments and by an empirical method. Yet the archivolt e f, that was only a penetration and was not detached from the vault, must support the wall of the axis, and could not be made of rubble or concrete on a mould, and it was necessary to construct it in cut stone. Hence one conceives the difficulties, that assailed the constructors. Properly speaking, there are no archivolts here, but skew tunnel vaults penetrating an annular tunnel vault. Thus one soon recognizes that there is an advantage in separating the archivolt from the vault, in making it independent. But then how to support the imposts of these archivolts on the square abacuses of the capitals? Here is drawn the abacus (see A, Fig. 17), the archivolts are projected in D D. We draw the imposts or the first voussoir of this archivolt at a a; there will remain between their extradoses on, y the bearing b, and





the space  $c d$  for the springing of the vault. But as the springings of the archivolts are higher than those of the section of the annular vault, it results from this, that if one desires the groin to spring from the abacus, these groins are separated from the verticals and form reentrant angles  $e c f$ ,  $g d h$ , with a meagre and disquieting effect, indicated by the perspective sketch  $A'$ . If these are good reasons for making the archivolts independent of the vault, one must at least find them as good for turning the transverse arches springing from the isolated column to reach the engaged column of the side aisle; transverse arches that must facilitate the construction of vaults turned by dividing the annular tunnel vault into bays. But where is to be placed on the square abacus the impost, the first voussoir of this transverse arch? If (see B, Fig. 17) we claim to leave the two first voussoirs of the archivolts and the first voussoir of the transverse arch independent on the abacus of the capital, it is necessary for us, either to give a little bed to each of these voussoirs, or to increase very much the top of the abacus, and in that case there will remain two unoccupied angles of this abacus; all the loads will come to rest on  $M$ , i.e., inside the axis of the column, and will tend to make it inclined. Further (see perspective sketch  $B'$ ) the springings of the archivolts being at a higher level than that of the springing of the transverse arch, there will remain above the springing of that arch a vertical triangle  $T$ , and the groin of the vault can commence only at  $i$ , the point where the curve of the penetration touches the extrados of the transverse arch. There is no need of insisting on the bad effect of this combination. If (see C, Fig. 17) from these three arch members we form an impost composed by the intersection of the beds of the arches, they will become independent only when the curvature of their extrados is detached from the vertical; but since the springings of the arches are not on the same level (see perspective sketch  $C'$ ), we shall again have at  $t$  a vertical triangle, that will carry the springing of the groin to  $s$ . For artists that seek forms most appropriate to the purpose, those transferred groins, not springing from the bottom of the reentrant angle, having the appearance of resting on the spandrel of the transverse arch, cannot be a satisfactory solution. These archivolts and transverse arches resting like a "bec de flute" (flute mou-





mouthpiece) on the abacuses do not present a construction conformed to the principle of the vault borne on projecting arches; principles that require each of these arches to retain its form and dimensions in its entire extent. The masters they attempted other combinations. At first they thought that the transverse arch, that bears no load, could be reduced in width, that apparently left more bed to the first *voussoirs* of the archivolts and allowed the vault to spring from a lower point. For some time they adhered to this last system while cheating as much as possible, either by giving more depth than width to the abacus, or by corbelling the first *voussoir* out a little on the abacus, so as to detach it. Still the construction of the vaults themselves had followed this progress. At first made of rubble laid on a form, their springing was soon made of cut stone, and then one attempted to construct them entirely of dressed and jointed rubble. For stonemasons not familiar with the art of drawing, as we are speaking of the first years of the 12th century, -- it was not easy to trace the jointing of the circular cross vaults; thus those first jointed vaults present the most eccentric joints, and the most naive expedients. Without experience, those artists had tenacity and saw a definite purpose, and they give us no small instruction, when we are willing to follow step by step the stages, that they made in the art of construction, without abandoning for a single day the path traced by their first attempts. Their deductions are connected by a rigor of logic, whose equivalent can be found at no other epoch; and especially in Ile-de-France one verifies the persistence of constructors in following the consequences of an adopted principle.

The side aisles of the collegiate church of Poissy were built from 1125 to 1130. Being supported at the side next the sanctuary on single columns, the vaults of these side aisles already possess separate transverse arches and archivolts with springings at the same level; it results from this that the cross vaults spring in the reentrant angle formed by the extrados of these arches, which are nearly independent. We say nearly, because the architect has cheated in separating as much as he could, the springings of these arches without loading the columns too unequally. For that he has given a little more projection externally to the abacuses of the capitals, and these not being





square but with their sides normal to the curve of the chevet. (See A, Fig. 13). This constructor has further doubled the archivolts of the side of the aisle so as to raise the vaults, and to cause the extrados of this second arch to have a greater radius. From a to b exists a thick side arch -- considering the distance between the engaged piers P P -- as much greater than are the radii of the archivolts of the transverse arch. Thus the architect has placed the springing of this side arch lower than those of the other arches, as indicated by the section C made on the axis O A. In spite of the lowering of this springing, the crown of the side arch rises above that of the doubled archivolt, and the vault presents a rampant section, that is further favorable to the introduction of light. It is necessary to turn vaults that also do not have diagonal arches. These vaults being constructed of roughed rubble, the constructor proceeded as indicated by the perspective (Fig. 19). He has connected the voussoirs at the intersection of the tunnel vaults forming groins by means of skew cuts made on the job. One conceives that this structure cannot be very solid, and that these groins only support themselves because the angles that they form are very obtuse. Their appearance not being satisfactory, men did not delay to guard against these inconveniences. But it is necessary for us to glance at what was done at about the same epoch in other provinces, where the Romanesque school had shown great splendor.

In Auvergne from the end of the 11 th century, as we have seen, the school of constructors had brought into the construction of curved vaults notable improvements, yet without seeking with as much tenacity the solutions of the set problems, as did the school of the North.

We find a curious example of this fact in the church S. Julian of Brionde, whose choir was entirely rebuilt in 1140. Before passing over and following the rapid advance of the constructors in the North of France, it is necessary to stop an instant before the vaults of the apsidal side aisle of this monument. While at S. Denis in France, Suger caused the reconstruction of the church of his abbey according to an entirely new system of construction, there was erected the apse of the church of Brionde. There the annular system without transverse arches is still accepted: the archivolts alone open into the sanctuary







penetrated by tunnel vaults normal to the curve of the sanctuary, and consequently forming cross vaults. At the windows lighting the side aisle between the chapels, tunnel vaults of diameters smaller than the bays penetrate the annular tunnel vault. But what must be the object of a careful examination of these vaults, is that they are entirely cut and are no longer constructed of concrete, rubble plastered, or even of rubble cut and fitted together as in the side aisle of the church of S. Louis of Poissy.

On their part the people of Auvergne also sought progress, but only in the mode of execution, without changing anything in the Romanesque system. Here (Fig. 20) is the jointing of one of those curved cross vaults. At A is the archivolt opening into the sanctuary.

One sees that the architects of Auvergne at the middle of the 12<sup>th</sup> century had not yet adopted the separate transverse arches, and that the stone vault rests directly on the abacus of the capital. However irregular as it is, the jointing of the groins is conformed to the theory, and is composed of stores of quite large volume cut with care. Between the apsidal chapels, here (Fig. 21) is how are arranged the penetrations of the openings that light the side aisle. The engaged columns support the vault itself and not the arches, which in the provinces of the North at that epoch, are already loaded to support it. Yet in the first bay of the side aisle of the choir of Notre Dame du Port at Clermont, whose construction is more than 50 years earlier than that of church S. Julien of Brioude, one notes a separate transverse arch, projecting very little it is true, and consequently in part imbedded in the vault itself, but which finally already indicates the tendency to divide annular vaults into bays. This example was not followed in the circular side aisle of Brioude, whose vaults are still frankly Romanesque in combination, but constructed with more knowledge and care. Having shown the tendency of that central province to not abandon its Romanesque traditions, even for the construction of annular vaults placed on isolated piers, and that require entirely novel combinations, we shall follow the advance of the rapid improvements introduced into the structure of the vaults belonging to the edifices of the North.

By referring to Figs. 1, 2, 5 and 8 of this Article, one will





observe that the Romanesque vaults, which present a perfectly homogeneous structure if only considered superficially, in fact consist of ribs and of neutral parts, or if one prefers that definition, of a framework and of fillings made as light and as inert as possible. We have given the two principal reasons causing the adoption of this system; it first is the economy of carpentry centerings; the second is the advantage of turning vaults according to a rapid method that ensures their homogeneous structure, uniform drying of the mortar, at the same time as a perfect solidity of the greatest lightness possible. We have seen that in the construction of cross vaults, the Romans imbedded brick groins in the thickness of the vault itself, just as they imbedded transverse arches in the thickness of t tunnel vaults and ribs in the thickness of domes. This method was judicious, not to be attacked from the point of view of a solidity; was it so from the point of view of art? If architecture has as its object to conceal none of the procedures in construction that it employs, but on the contrary to emphasize them by giving them proper forms, it is evident that the Romans frequently mistook that principle; for when the vaults were plastered and covered internally by stuccos and paintings, in combinations independent of the skeleton, it was impossible to know whether those vaults had or had not transverse arches and ribs in their structure. That resistant skeleton, judged necessary for their stability, was always visible: if it is partly accented in the dome of the Pantheon, it is no so in the vaults of the Baths of Antonine Caracalla, those of the basilica of Constantine, and in the great hall of the Baths of Diocletian. Thus the question is reduced to its narrowest limits. Should not all construction be for the architect the motive of an arrangement intelligible to the eye? The Greeks, justly so extolled as artists and so little understood, in applying their principles, have they done anything in their architecture but to regard the construction as the reason determining every form! Where have they concealed the least members? And those little edifices of central Syria mentioned above, are they not the most vivid expression of that feeling of the Greek, that led him in matters of architecture to regard all construction as the element constituting the visible form, even after he suffered Roman influences, so contrary to the taste of the Greek?



[illegible]

But the Greeks of the late time in central Syria did not build cross vaults of great dimensions. They accepted from the Roman inheritance only the arch, tunnel vault and dome. Yet they appropriated these forms while adding to them their rational arrangements, and these tendencies are very marked, for the western men could follow that course, when they saw those monuments at the end of the 11 th century, but going much farther than had been done by the inhabitants of those little cities scattered over the route from Persia to Byzantium.

Now one can ask from all men of good faith; to admit the principle of construction of Roman vaults, to become inspired by the analytic mind of the Greek, by his taste for truth, his innate feeling for form, for to constitute a complete system from those elements, is not that an advance? And is it right to reject as superannuated this system, if otherwise one only knows how to reproduce the apparent form of Roman construction, without taking from it what forms its principal merit, economy of means and simplicity of execution? We believe it sufficient to propose these questions, that everyone may decide where progress stopped and where decadence commenced.

To adopt the Roman vault, but to reason like those western artists of the 12 th century is in our eyes one of the most complete revolutions and best justified, that have ever occurred in the domain of architecture. What said those artists themselves! "In constructing their vaults, the Romans considered two objects, a skeleton and a neutral filling; but from these two distinct objects they derived only a visible form, a concretion, thus confusing the part that supports, the essential thing, and the part supported or inert. If the intention is excellent, if the material result is satisfactory, the result is vicious as art; for in the art of architecture, which is a sort of creation, the real function of each member must be emphasized by a form in accordance with that function. If a vault can support itself only by a framework of ribs, this framework is not intended by art to be concealed, it must be visible, the more apparent as it is more useful. The Greeks accepted this law without allowing any exceptions. That the western architects reasoned thus in the midst of the 12 th century, we do not affirm; but their monuments do this for them, and that suffices us.

Romanesque architects had first adopted the tunnel vault as







being the simplest and most easily constructed. Already about the end of the 11<sup>th</sup> century, they had ribbed those tunnel vaults, not by arches and more resistant materials imbedded in the thickness of the vault itself, but by projecting<sup>1</sup> transverse arches giving greater strength to these tunnel vaults at the points of support. The continuous thrust of this kind of vaults soon caused them to be abandoned. Then remained for vaulting the great spaces of halls and naves the cross vault and the dome on pendentives, then perfectly known in the West, since for more than a century domes on pendentives had been built in the West and the Centre of France.<sup>1</sup> The Roman cross vault formed by the intersection of two half cylinders gives as the curve of junction a plane curve, that justly worried constructors no longer possessing the excellent mortars of the empire.<sup>12</sup> The dome on pendentives required much height and needed a complicated and expensive centering of carpentry. As we have already stated, those masters of the 12<sup>th</sup> century then sought a mean between those two structures; they raised the crown of the cross vault just as the Byzantines had done. (Fig. 10). But, and here appears the real innovation in the art of construction, -- they caused to project from the Roman or Byzantine cross vault the rib imbedded within it, built it of dressed and resistant materials, and set on the centering of carpentry; then instead of constructing the vault around the rib, they built it above this, then regarding that arch left to project below the work as a permanent centre. In the porch of the abbey church of Vezelay are already seen two vaults so constructed (about 1130); but in the abbey church of S. Denis (1140) the new system is completely developed. The vaults there are rather domes than cross vaults, but without exception they are all ribbed parallel and diagonally by projecting stone arches, and these arches are all third point, i.e., formed of circular arcs intersecting at the crown. The logical deductions from this system were not delayed. In the Roman vault composed of cells, as we have seen in Fig. 1 etc., the fillings of these cells is supported but is inert and <sup>has</sup> no curvature that could transfer the weight to the walls of the cells. Since the constructors of the 12<sup>th</sup> century detached the ribs from the vault, making permanent centres, it was natural to vault the fillings on these ribs, i.e., to give them a curvature in all directions, that should actually transfer





their weight to those arches. Thus the vault was composed of several vaults, as many compartments as void spaces left between the arches. From the solid Roman system -- in spite of the different members composing the Roman vault, -- the masters of the 12 th century by separating those members and giving to each its real function, attained to the elastic system. Much more, they inaugurated a method of construction by which were avoided all the difficulties, some of which we have indicated above, and this gave them the liberty of vaulting without trouble and without extraordinary expense, all those spaces, however irregular, taking the heights that suited them, both for the springings of the arches and for the level of the crowns.

Note 1.p.500. Art. Construction, Fig. 3.

Note 1.p.501. Art Coupole.

Note 2.p.501. Art., Construction, Fig. 4.

The vaults of the porch of Vezelay (1130), some of which are already turned on diagonal arches, are built of irregular rubble bedded in mortar, but this masonry does not transfer accurately to those groins the weight of the masonry triangles; if these were removed, the vault would still stand, as there still remain vaults in the same edifice from which the diagonal arches have been removed. Here the diagonal arch is rather the means of giving strength to a weak point, of emphasizing what a structure required by necessity. This is an expedient and not a principle. It would not be accurate to regard the projecting ribs, the diagonal arches (to give them their true name) of the vaults of the porch of Vezelay as the first attempt of a new principle; it is an advance toward a new principle not yet seen. In fact in the art of architecture, and particularly in the practice of that art, principles do not grow ready formed in the brains of constructors, there is always a sort of intuition of the principles before their statement. To replace temporary wooden centerings by permanent centres of stone was an ingenious idea, derived from the Roman theory of the stability of vaults; it was not a novel principle; it is not a new principle to cause to project under the vault the rib imbedded in the vault; this is a simple logical deduction. But to regard these ribs outside the vault as an independent framework, and to combine on that skeleton a series of vaults, that can only support themselves because they rest on that framework, that





is then a new principle established, which has no connection with the principle of Roman construction: it is a discovery, and one so important in the art of construction, that we do not know with what it can be compared. Constructors thus freed themselves from all the difficulties, that presented themselves at the establishment of vaults on irregular plans, and notably on curved plans. One must place himself at this point of view, if he desires to render an account of the value of this innovation; not to consider alone the appearance of the vaults, but their mode of construction. Now there exist many ribbed vaults, that are not cross vaults, i.e., which are not constructed according to this principle before unknown, consisting in a series of vaults supported on arches turned in all directions, whatever the shape of the plan to be covered. We have attempted in Art. Construction to emphasize the difference between the principle of the ribbed dome, and the principle of the cross vault, although these two vaults may have the same appearance or nearly so; <sup>1</sup> it would seem that our treatment of that subject was not sufficiently extended, since learned critics have not been able to appreciate all the importance of that difference. Yet it is such, that the system of the ribbed dome, successively improved and amplified, leads to a structure limited in means and that cannot lead to extended results, while the system of the cross vault lends itself to all possible combinations, without ever resulting for the construction difficulties in the execution, either in drawing, mode of centering, or in jointing the masonry. First in the church of the abbey of S. Denis built by Suger, frankly appears the application of the last system. In Articles due to our learned friend E. de Verneilh, too soon removed from archaeological studies, <sup>1</sup> it is stated that the vaults of the choir of the abbey church of S. Denis are a derivation, a result of those that surround the choir of the collegiate church of Poissy, whose construction we have shown, (Figs. 18, 19). We cannot adopt that opinion; the vaults of the circular side aisle of Poissy do not mark the origin of the principle accepted in the church of S. Denis. Those vaults of Poissy are Romanesque vaults that attempt to free themselves from the difficulties pertaining to the Romanesque mode of construction, but which in nothing allow a suspicion of the new system inaugurated at S. Denis. Then we persist in stating that







the embryos of this system are lacking to us, that they no longer exist, or that the church of S. Denis suddenly presents in 1140 a first complete example of this mode of construction of vaults. We shall proceed to judge.

Note 1.p.502. Art. Construction, Figs. 62 to 72 bis.

Note 1.p.503. Annales Archéol. Vol. XXIII, p. 1 to 18, 115 to 132.

Fig. 22 presents at A the plan of a half chapel around the side aisle of the abbey church of S. Denis, with the double circular side aisle. This plan being given, if one proposes the problem of vaulting it by the aid of the Roman or Romanesque systems, the solution would be impossible.

By what artifices of penetrations could one vault the chapels? By domes? Perhaps; but then it would be necessary for those domes to rest on arches, to establish pendentives, and then to occupy a considerable height. Besides these skew pendentives are irregular and produce a very bad effect. In establishing his plan, the architect of the apse of S. Denis knew how he was going to vault it; or to speak more truly, it was the system of vaults to be employed that gave him the arrangement of his plan. First the external circle, that served him for tracing the perimeter of the chapel strikes at a the abacus of the single column b, so that the branches of the diagonal arches a c, d e, e c, are equal to each other. Having drawn the transverse arch f of the archivolt g, he takes the middle of the axis g f, and traces the two branches b i, h i, of the diagonal arches, and then traces the transverse arches h b, b l. It is clear that all these arches are independent; the architect is the master in placing their springings where he thinks proper. But (and here appears the necessary results of the system adopted), if he had traced these arches as round, either it would have been necessary for the springings of these arches to be at very different levels, if it were desired to have their crowns raised to the same level, since those arches are of very different diameters, and thus arise difficulties that we have previously mentioned for closing the triangular vaulted compartments; or if the springings of those arches had been placed at the same level, their crowns would have reached very different levels. Then the architect employs the third point or pointed arch, that ensures to him all liberty to give to the crowns the





the proper heights. Thus the revolved portion B indicates at l'b' the transverse arch l b, at b'h' the transverse arch b h, at c'e' one of the branches of the diagonal arches of the chapel, at o b' the transverse arch b f, at b'i' the branch b i of the diagonal arch b i, at b"p that of h i. It results from this drawing that the crowns c, f, i, are on the same level, and that the crowns of the two transverse arches h b, b l, are also on a single level line, lower than that of the three crowns c, f, i. It remains to turn the vaulted triangles on this skeleton, which rest on these pointed arches. The lines of the crowns of these fillings necessarily abut at the highest point of these arches and give the dotted projections i g, c r, and pass in the axial line c g. A small difficulty presents itself in the main part of the chapel.

The architect must have pierced the windows D, not in the middle of the curve k s, but nearer the central pier e, so as to avoid the buttress C. Now the archivolt of that window taking the place of a side arch, its crown is found at t; the line c t of the crowns then divided very irregularly the triangle k e c; and there remained from k at s a space between the extrados of this archivolt and that of the branch of the arch k e c, which could embarrass the mason charged with turning the vault on the triangle k e c. The perspective view E shows at F how that little difficulty was solved. The vaulted filling begins as commenced a dome on a circular part; then the curved surface became skew as it ascended, and sought the extrados of the archivolt and that of the branch of the diagonal arch. At G a horizontal projection indicates the arrangement of the rows of dressed rubble at the springing of the curved surface between the arches. On the perspective sketch E, one sees that the archivolts of the windows acting as side arches penetrate the branch of the diagonal arch on the axis at its springing. One will also note that the springings of the diagonal arches of the chapel are at a level lower than those of the other arches, and that consequently the abacuses of the capitals drop one course. (See at Y).: Excepting some experiments, some parts not clearly studied, the system is complete and frank; the freedom of the architect is acquired, and from this first trial it is easy to attain the most extended results. The perspective sketch E shows well, that the triangular fillings in cut rubble transfer



The first of these is the fact that the majority of the population of the United States is of European descent. This is true of the United States, Canada, and the British Empire. The second is the fact that the majority of the population of the United States is of European descent. This is true of the United States, Canada, and the British Empire. The third is the fact that the majority of the population of the United States is of European descent. This is true of the United States, Canada, and the British Empire. The fourth is the fact that the majority of the population of the United States is of European descent. This is true of the United States, Canada, and the British Empire. The fifth is the fact that the majority of the population of the United States is of European descent. This is true of the United States, Canada, and the British Empire. The sixth is the fact that the majority of the population of the United States is of European descent. This is true of the United States, Canada, and the British Empire. The seventh is the fact that the majority of the population of the United States is of European descent. This is true of the United States, Canada, and the British Empire. The eighth is the fact that the majority of the population of the United States is of European descent. This is true of the United States, Canada, and the British Empire. The ninth is the fact that the majority of the population of the United States is of European descent. This is true of the United States, Canada, and the British Empire. The tenth is the fact that the majority of the population of the United States is of European descent. This is true of the United States, Canada, and the British Empire.

their weight to the ribs, are turned on their extradoses, and that those already at S. Denis exactly fulfil the function of permanent centres supporting the vault or rather a combination of vaults. By a remnant of respect for tradition, perhaps also by a lack of absolute confidence in the goodness of the new system, the crowns of the side arches and lateral transverse arches are kept lower than those of the diagonal arches, so as to leave to the combination of triangular vaults a general domical form. This system persisted until the first years of the 13<sup>th</sup> century.

What proves how radical and novel is the system of vaults adopted in the reconstruction of the abbey church of S. Denis, are the contemporary or slightly later monuments, in which one again perceives hesitations and remains of Romanesque traditions, from which the architects have not dared or could not free themselves. From this point of view, the vaults of the cathedral of Sens merit a thorough examination. M. Challe at the scientific congress at Auxerre in 1859 perfectly established, that the cathedral of Sens could not have been rebuilt after the fire of 1184; but one cannot admit that it was commenced by archbishop Henry of France after his enthronement, i.e., 1122, ten years before the earthex of the abbey church of Vezelay. The character of the architecture, the mouldings and the sculptures, cannot make it supposed that the cathedral of Sens was commenced before 1140, little before the death of archbishop Henry. Indeed the texts state that he began that edifice, but not at what time of his episcopate that foundation occurred. Now in 1137 abbot Suger commenced the reconstruction of his church, in three years and three months he had completed the choir. Admitting that the cathedral of Sens may be contemporaneous with the church of S. Denis, they were still working on it in 1177, and its erection was continued slowly.

The cathedral of Sens then cannot pass as having served as a starting point for the works of S. Denis, and the vaults of S. Etienne of Sens show an indecision (especially the lower vaults) and experiments, that no longer appear at S. Denis.

Let us examine (Fig. 23) a half bay of the nave of the cathedral of Sens. The vaults of the side aisle A have transverse arches C, that are round (see the revolution at C'). But the bays of the nave being double (hexapartite), i.e., alternately







composed of great pieces P to support the transverse and diagonal arches of the high vaults, and of intermediate piers S composed of coupled columns intended to bear only the arches intersecting the high vaults, the diagonal arches of the low vaults resting quite awkwardly on these piers. The diagonal arches revolved at D have their branches unequal, a b being shorter than b c. At c the constructor, not having reserved a little column to receive this branch b c, must place a corbel at the height of the impost of the transverse arch and of the side arch (see the perspective sketch G); thus he has been able to diminish a part of the difference in length of the diagonal arches. These branches of the diagonal arches rest elsewhere on the projection of the abacuses of the capitals of the coupled columns S a and on the little engaged columns of the great piers. Although the transverse arches C are round, the archivolts E of the nave are pointed (see their revolution at E'). Besides the crowns of the diagonal arches attain the level d above the level of the crowns of the transverse arches and the archivolts; so that these vaults are strongly swelled, and are constructed of cu rubble, as stated above. This mixture of the round arch and of the pointed transverse arches and archivolts is nowhere found in the construction of Suger at S. Denis. The branches of the arches are more skilfully placed at S. Denis. One does not see there those corbels, that appear to have been an expedient at Sens, and which we also find in the low vaults of another monument in Champagne, at Notre Dame of Chalons-sur-Marne. Now if we pass to the high vaults built some years later (especially that as we have stated that the works at Sens were slowly conducted), we find a system of vaults quite interesting to study, because it illustrates several questions concerning the construction of these important parts of our edifices of the end of the 12 th century. These high vaults are on a square plan with an intermediate transverse arch; a method adopted with rare exceptions for the navves of the second half of the 12 th and beginning of the 13 th centuries. <sup>1</sup> At Sens this arrangement of the high vaults is perfectly indicated by the forms and dimensions of the piers. The diagonal arches P M are round; <sup>2</sup> their revolution is at p m. The intermediate transverse arch S M is revolved at s m. The transverse arches P O are revolved at r o. As for the (old) side arches, they were round and are revolved





at n t. One will note that the curve of the extrados of the diagonal arch (revolved) intersects at v the side arch at the level of the extrados and its crown (in vertical projection), so that the line of the crowns of the triangular fillings M g (in horizontal projection) is given by the curve v m of the extrados. The half triangle M g h is then a section of a dome, and can be constructed according to the mode suitable for that kind of vault, i.e., by a series of courses of concentric rubble stones. There is a point that should not be lost from sight, for it clearly indicates, as we claim to have established in Art. Ogive, that the form of the dome still preoccupied the architects of the first so-called Gothic period. Yet the rows of rubble of these fillings are set parallel to the line M g of the crowns, so as to transfer the weight of these fillings entirely to the transverse and diagonal arches. But one might object that the round side arches exist no longer and were replaced at the end of the 13 th century by others, pointed and much higher, and that we establish our drawing only on a hypothesis. Here then (Fig. 24) is the proof of the preceding drawing. At A is the horizontal plan of the springings of these great vaults of the cathedral of Sens. B is the transverse arch; C the diagonal arch; D the intermediate transverse arch. At E is drawn the section on the great axis, and that part of the vault. The little columns c still exist in place with their capitals, and in the bays of the choir the branches b c of the side arches have been left below the side arches raised at the end of the 13 th century. These elements suffice to indicate the height and precise form of the old side arches of the 12 th century. But let us see what also supports our restoration. For the length of the nave the cornice F is preserved; below is an ornamentation by little round arches, that rest on an arch that formerly necessarily opened above the vaults as indicated by the section G. The cornice F was raised to allow the ties of the carpentry to pass above the extrados of the vaults; and this arch G gives light and air under the roof. In the choir of the abben church of Vezelay, which dates from 1180 to 1190, the side arches are likewise round, and are thus arranged below the crowns of the vault. The high vaults of the church Notre Dame of Chalons-sur-Marne possess in the choir stilted round side arches. Thus there is nothing in this arrangement not conformed to the construction





of the vaults of edifices near Sens, or belonging to the same province. The dotted line g h indicates the plane of the side arches rebuilt at the end of the 13 th century, side arches that surround the great tracery windows, whose archivolts now intersect the remains of the arcade formerly opened above the vaults. Fig. 25 gives this arcade on the exterior, the traces still in place and numerous fragments permit its restoration without difficulties. <sup>1</sup> In piercing new windows, the architects of the 13 th century were contented to close the openings formerly looking under the roof, and to cut into the jambs and round archivolts according to the curve of the archivolt of these new openings. One still sees in place at several points the capitals C, portions of archivolts, and the entire upper part B. At A are the heads of the flying buttresses dating from the primitive construction. This upper arcade opening above the vaults is again found in many Romanesque churches of the Rhenish provinces, and had penetrated as far as the eastern parts of Champagne. Its presence at Sens is no less a very remarkable fact.

Note 1. p. 508. Arts. Construction, Ogle, Trovee.

Note 2. p. 508. Today the centre of these arches is at I; but after removing the centering occurred a slight lowering of the crown, and later a small separation of the walls, that must slightly deform these arches, whose centres must be placed on the upper line of the abocuses.

Note 1. p. 510. It is due to the courtesy of M. Lance, diocesan architect of Sens, and the intelligent borings made by his inspector, M. Lefort, that we have been able to recover accurately this arch, that presents so curious an arrangement. In our restorations the form of the windows is all that is doubtful, although the jambs of those windows are still masked on the exterior, and coincide with the jambs of the arcade of the triforium. (Art. Triforium).

It results from this study that the high vaults of S. Etienne of Sens were very swelled, presenting concave triangles strongly inclined to the exterior; that the constructors dared not free themselves from the generating form given by the dome for the drawing, although they had already adopted the method of construction of triangular vaults for the fillings, transferring the loads to the transverse and side arches; at least that







appears probably, since this method is adopted for the vaults of the side aisles, that are older, and for the high vaults of the choirs of Vezelay and of Notre Dame of Chalons-sur-Marne, that are of the same time or nearly so, as these high vaults of the cathedral of Sens. The triangles taking the side arches as bases, having been rebuilt at Sens at the end of the 13<sup>th</sup> century, -- although the diagonal and transverse arches were not changed, -- however we cannot positively affirm that the courses of rubble of these triangles were set parallel to the line of the crowns (Fig. 24). It would be possible for the courses of rubble of the half triangle  $s i l m$  to have been set parallel to the line  $l m$  of the crowns, and that the rubble of the half triangle  $n l m$  was set in horizontal courses, since the line  $l m$  was only a segment of the diagonal arch (extrados), and that consequently this half triangle  $n l m$  was a portion of a sphere penetrated by the side arch. This construction would have been very singular and exceptional if not adopted. Yet then was such freedom there in the manner of setting the fillings of cross vaults, that no conjecture should be absolutely rejected. Due to this liberty, the architects of the second half of the 12<sup>th</sup> century were able to vault without difficulty irregular areas, and notably triangular spaces between piers, as may be seen around the choir of the cathedral of Paris. The sanctuary of Notre Dame of Paris is surrounded by double side aisles (Art. Construction, Fig. 44); the second row of piers naturally being farther apart than the first, and the third than the second; the architect has multiplied the points of support so as to present always openings of nearly equal spans. Fig. 26 gives a bay A of the sanctuary of Notre Dame of Paris, the first side aisle B and the second row C of the cylindrical columns. D are archivolts; E are concentric transverse arches; F are radiating transverse arches, and G are diagonal transverse arches. All these arches are pointed, so that their intersection and highest point is at d for the first, e for the second, f for the third and g for the fourth. To vault those triangular areas, the constructor has connected the highest points of the extradoses of the arches F and G by curves or swelled crown lines  $f g, g g, g f$ . He has vaulted by curved surfaces, by courses parallel to these crown lines, the triangles  $g g o, g f l$ , by setting in the ordinary manner each of these





courses of roughed rubble on the extradoses of the branches O g, I g, I f, of the arches. The highest point of the crown lines f g and g g is at h, and this point is at a level sensibly above the highest points d and e of the archivolts D and the transverse arches E, since the radiating transverse and diagonal arches F and G are drawn on a greater diameter, and their crowns are thus already higher than those at d and e. Those crowns at the highest points d h, e h, have then been connected by a curve; then imaginary lines have been drawn from l to h, from k to h, and i to h; these lines are <sup>es</sup> curves by which must pass the courses of rubble. The extrados<sup>es</sup> l and e of the transverse arches have been divided into a number of equal divisions according to the thickness of the courses of rubble; the same number of equal divisions was made on the curve l h, for example; then the lines joining these points gave the joints of the courses of rubble, which presents the structure sketched at H and P. Thus these concave triangles rest their weight on the stone arches connecting the piers. It is clear than any o<sup>in</sup>ther system of vaults could not solve such a simple manner t the problem of construction proposed in this case, and we shall even add, that the systec of the Gothic vault alone lends itself to close those triangles left between pointed arches. Thus see where the architects had already arrived in Ile-de-France about 1165. Still many improvements yet remained to be introduced into the method of constructing these vaults, particularly in t the mode of placing the arches on the piers.

To add groins either to the cross or the cloister vault, or to the spherical or polygonal dome, or rather to place under those vaults permanent centres of stone instead of temporary centres of carpentry, was a novel idea; as we explained at the beginning of this Article, it was to cause the skeleton imbedded in the thickness of the Roman vault to appear beneath that vault; it was to utilize it no longer as a reinforcement, but as a support and soon the only support; finally it was to render the skeleton independent of the vault itself and to allow the use of all possible systems of vaulting. Still the deductions based on this system only presented themselves successively. Thus the swelled-Byzantine cross vault being given, to reinforce the lines of intersection of curved surfaces by means of st stone groins within; to take from the swelled vault the arches





imbedded within the depth of the lines of intersections, to place them beneath those lines, so as to rest the triangles of the vault on the arches, was evidently the first idea that presented itself to the minds of the constructors in the 12 th century; but this removal of a member of the Byzantine vault, imbedded within its thickness to place it beneath the vault did not modify the vault; that remained, its framework is visible outside, and that is all. Now it is necessary to find the proper place to receive that skeleton, the novel presence of this framework requires additional bearing. That is indeed what occurred. Let (Fig. 27) be an impost A of a swelled Byzantine cross vault supported by isolated piers. The constructor has the idea of allowing these brick groins imbedded in the thickness of the vault to project, so as to build the vault no longer around these ribs, but above them. The operation that first presents itself is this; he chamfers the corners of the impost, and sets, not in brick but in cut stone the voussoirs b outside the angles. He will project the faces c of the transverse arches d. The entire impost thus modified will then occupy a surface f g h i, larger than that occupied by the impost of the primitive vault. It will further be necessary either that the capital be expanded considerably, or that the pier be larger. But still the architects in the 12 th century already felt it necessary to reduce as much as possible the points of support in the interiors of edifices. The new system adopted then seemed in contradiction to that accepted requirement. The capitals were enlarged; but not daring to load the entire projections of these curves corbelled from the face of the piers, then added to them, not a uniform increase of area, but supporting members, as we have shown in Fig. 9, that also permitted the reduction of the principal mass of the pier.

Thus originated those clusters of engaged columns, that are a first logical deduction from the new method of vaulting. Since the transverse and diagonal arches were removed from the Byzantine vault to appear beneath its internal surface, it was natural to take from the mass of the pier members to support these arches. The idea of absolute reduction of the entirety only came successively. One even sees in the oldest monuments vaulted according to the Gothic method, that because of the operation just indicated, the piers occupy an area relatively greater than







than that occupied by the piers of the last monuments of the Romanesque period. Men believed it necessary to find additional surfaces suited to receive the newly adopted arches. This arrangement is especially apparent in the provinces in which the work of transition from the Romanesque to the Gothic vault proceeds slowly and timidly. Thus the piers of the nave (without side aisles) of the church of the Trinity at Laval, which dates from the middle of the 12th century, bear a complete system of transverse and diagonal arches (Fig. 28). Here the architect believed it necessary to find on the abacuses of the capitals a clear place, or nearly so, for each of these arches, which are each independent above the imposts.

Yet in Ile-de-France from 1140 the arches intersect at their springing, as one sees around the choir of the abbey church of S. Denis. One notes indeed still many experiments and embarrassments, but the principle of penetration of the arches at the impost is already adopted.

At the cathedral of Senlis, whose construction is little later than that of the church of S. Denis (part of the apse), one sees that the architect has sought to cause the diagonal arch of the chapels to penetrate into the transverse arch of the width. Fig. 29 gives at A the angle pier of these chapels (small depth like those of the church S. Denis). The transverse arch of the entrance is at a and the diagonal arch at b. This diagonal arch starts on the column intended for the transverse arch. The perspective sketch B shows at a these penetrating transverse arches, and at b the diagonal arch. It is well understood that the imposts of these two arches are no longer independent, but are cut in the same courses up to the level y. Soon these arches are grouped more and more at the impost and penetrate each other, which allows the reduction of the section of the pier supporting them. The arches contracting into a cluster are in fact no longer a reinforcement or skeleton to support the vault, but become the vault, and the fillings closing the intervals between these arches are reduced more and more to the function of little vaults. The proof is that from the 13th century between the transverse and diagonal arches are added new and supplementary ribs. Thus is developed the principle adopted in the 12th century beyond the knowledge, so to speak, of those who first recognized it, by a series of





results linked rigorously. Such is in fact a property of the principles accepted in everything, that they became fertile, a necessary and a fated source of deductions. That is why we repeat constantly; take little account of forms, if you do not find them to your taste, but adopt a principle and follow it; it will give you the forms necessary and suited to the object, the time and the needs. And that is also why those that dislike to subject themselves to a principle, because it compels the mind to reason, hope to deceive the public by claiming, that the studies of our French architecture of the Middle ages result in causing the adoption of superannuated forms. Forms are not necessary in all that; a method is required; it is true that this is never admitted by the architects, by whom every method is regarded as a restraint in the development of the imagination, or to speak more correctly, in the satisfaction of their expensive caprices.

In the great edifices, vaults established as are the high vaults of the cathedral of Sens present in general the appearance of polygonal domes. The constructors dared not yet keep the crowns of those great vaults -- crowns of diagonal, transverse and side arches, -- all on the same level. Yet at the cathedral of Paris, the high vaults of the choir were completed before 1190, and are much less swelled than those of S. Etienne of Sens. It is clear that the more the vaults are swelled, the more necessary is it to raise lateral walls above the side arches to support the tiebeams of the carpentry, which must pass freely above the extrados of these vaults. There results from that arrangement a useless waste of materials, a heavy arrangement that must be occupied by an opening, if one pretends to make it lighter; but then is also a considerable expense for the secondary object. By raising the crowns of all arches to the same level, there is to be placed over the side arches only the cornice and a low wall suited to receive the carpentry of the roof. Then toward that result tend all the efforts of constructors from the beginning of the 13<sup>th</sup> century. The new system further lends itself perfectly to the leveling of the crowns, since the small filling vaults transfer all loads to the diagonal and transverse arches, never to the side arches, which rigorously could be omitted.<sup>1</sup> Already in the nave of the cathedral of Amiens, the crowns of the side, transverse and d





diagonal arches are nearly on the same level. It is the same at the S. Chapelle of the palace at Paris, and in many other edifices built from 1230 to 1240. The filling vaults retain a curvature in all directions, and they are concave, so that their crowning courses are curved.

Note 1.p.517. In fact there exists a very great number of vaults of the 13<sup>th</sup> and 14<sup>th</sup> centuries without side arches. The vaults of the cathedral of Clermont, for example, are without them.

In Art. Construction, this mode of construction is sufficiently detailed, that we do not have to enlarge here on that subject. But we shall state, that in spite of the curvature given to the triangular surfaces of the filling vaults, if they were of very large dimensions, as the crowns of those arches were brought to a level, one fears the loosening of those wide curved surfaces, and he seeks to reinforce them between the transverse and diagonal arches by ribs, to which was given the name of ribs in the 16<sup>th</sup> century. These supplementary arches abut against the rib extending from the crown of the transverse arch to the crown of the diagonal arch. Perhaps to the central vault of the transverse aisle of the cathedral of Amiens, this system was applied for the first time.<sup>1</sup> This square vault that spans an average of 47.3 ft. between axes of piers, probably appeared too wide to the constructors of that edifice to be built according to the method accepted until then. We present (Fig. 30) the plan of a quarter of this vault. At the centre C is a crown opening for the passage of the balls of the spire. The ridges are projected at a b and the ribs at e f. These ribs join the middle of the ridges. At A B we have drawn the revolution of the transverse arches; at G E that of the diagonal arches; at G F that of the ridges, and at H E the vertical projection of the ribs. It is evident that the crowns of the arches attain very nearly the same level. The ridges are curved and are turned to be able to support themselves, and receive at F' the ends of the ribs. The courses of rubble of the filling vaults are no less set parallel to the lines of the crowns, i.e., to the ridges, and the ribs are only there to reinforce those courses of rubble at about the middle of their curvature, whose rise is given by the ridge a b.

Note 1.p.518. The construction of this vault seems to date from







the end of the 13<sup>th</sup> century, perhaps from 1270. It was partly repaired later, quite unskillfully, after the burning of the first spire; but it is certain that the ribs and ridges existed before that epoch, for the starting points are old.

The adoption of this system in England was combined with an arrangement peculiar to that country, of courses of rubble in the fillings (Art. Construction, Figs. 62 to 72); which produces combinations of vaults entirely different from those adopted by the French school.

About the end of the 13<sup>th</sup> century in Normandy are already seen vaults, whose transverse and diagonal arches have their crowns at the same level, and that are connected by horizontal ridges, not curved. This is a sort of mixed system, between the English system, to which we shall soon return, and the French system. The central vault of the transverse aisle of the cathedral of Bayeux, which dates from that epoch, gives us a remarkable example of this sort of structure (Fig. 31). At A is projected the quarter plan of that vault, pierced by an eye for the passage of the bells. From a to b are horizontal ridges without extra ribs. The transverse arches are revolved in B C, the diagonal arches in D E, and the ridges are projected at G H. These horizontal ridges are not jointed as platbands, for their great length and weak section would not have permitted it; they pass through the rubble filling, which thus supports them like a line of keystones. The section H illustrates this jointing. In their greatest curvature, i.e., near the transverse arch, the courses of rubble are inclined according to the lines g h, and in approaching the eye these curves naturally take a much flatter curvature i h. The ridge is then held by the abutment of these courses of rubble, it loads and strengthens their point of junction. In such a case the triangular fillings are rather parts of cylinders than concaves as in the preceding example. The sketch M gives the projection of the eye with the beginning of one of the diagonal arches O and of a ridge L. These connections are reinforced by cusps as gussets, that give strength to the points of junction. See (Fig. 32) how are jointed these connections of the arches with the eye. The eye is composed of eight pieces. The four corresponding to the diagonal arches are naturally held in place by their joints normal to the arch; the four corresponding to the ridges are like-





likewise held by an oblique joint a, so that the last piece b of the ridge is longer from the intrados from e to f, than on the extrados from g to h. Yet this piece cannot fall, any more than those preceding it, since all are held and supported by the triangles of the fillings at the tail p. Fig. 32 allows one to appreciate the utility of the cusps that reinforce the junctions of the branches of the arches and of the ridges, thus preventing the ruptures produced at the crown and occasioning serious disorders in the vault. As always, the practical element, a necessity of jointing or of construction, here furnishes a motive of decoration. It is necessary to extend a little on to the Anglo-Norman system of vaults. This study is interesting because it shows how, in starting from the same point of the same principle, the two English and French systems have reached very different results, while both remaining rigorously faithful to this principle.

This is the best reply that can be made to those that regard principles as a restraint, and who on the contrary only believe that from their deductions can be derived new forms.<sup>1</sup>

Note 1. p. 521. In Art. Construction we have already indicated the results derived by the Anglo-Normans from the vault of the 12<sup>th</sup> century.

From the 13<sup>th</sup> century was recognized in the construction of vaults the influence of Anglo-Norman or Anglo-Saxon genius, if one prefers, for our neighbors do not voluntarily adopt the name of Anglo-Normay. It is then understood that we shall not quarrel about a word.

We have seen that in France, or rather in Ile-de-France, already at the middle of the 12<sup>th</sup> century, the fillings of cross vaults are closed by means of courses of roughed rubble set perpendicular (in horizontal projection) to the side aisles, so that these courses of rubble join parallel to the line of the crown or ridge. To obtain this result, we have shown (Art. Construction, Fig. 55) how the detailer made on the extrados of the curve of the side arch and on the extrados of the curve of the diagonal arch an equal number of divisions forming the joints of the courses of rubble. Now since the curve of the diagonal arch is longer than that of the side arch can be, the divisions on the diagonal arch are larger, being in number equal to those of the side arch. In Normandy and on the other side of the





until about 1220, men proceeded in exactly the same manner; but particularly in England from the beginning of the 13<sup>th</sup> century, was manifested an indecision in that mode of drawing the fillings of vaults; they evidently sought a more practical and more expeditious mode, and especially one that could be stated in a more distinct fashion. In fact the filling triangles of the French vault being concave, those courses of rubble could not be generally drawn on the diagram; they were set by the mason, who cut them to size as required by the plank centre mentioned in Art. Construction, an of which we shall soon speak, again. It was then necessary for the workmen charged with this need to be sufficiently intelligent, to have a sufficient initiative, to be able to arrange alone and without the aid of the master stonecutter those courses of rubble, concave on the intrados and consequently wide at the middle of the course than at the two ends. In that mode of procedure was a little "nearly so," a feeling that does not enter into the precise and practical genius of the English, may one say, who claim to leave nothing to chance in the order of things, that can be materially foreseen and defined. Then to return to the subject occupying us, English constructors like our own, having adopted pointed arches for the construction of cross vaults, divide the side and diagonal arches in order to turn the courses of rubble of the fillings, no longer into an equal number of divisions, but into equal divisions. Thus (Fig. 33) let this be a cross vault on a square plan; the revolution of the side arch being a b, and that of the diagonal arch c d, if each course of rubble gives on the side arch the divisions a e, e f, f g, etc., the same divisions are transferred to the diagonal arch from c to l, l to m, etc. Thus (these divisions being equal) there will be a greater number of widths of courses of rubble on the diagonal than on the side arch. Then joining the points e'l', f'm', etc., we shall have the directions of those courses of rubble that from o meet on the line of the crowys. The setter then only has to place rubble of equal widths; the lines of the joints will incline toward the diagonal arch, although the triangular surfaces pass through a series of horizontal straight lines. The triangles can be turned without centerings or even a plank centre, a wooden joist placed from V to X sufficing to receive temporarily the junctions of the last co-







courses of rubble. Not between two days did men reach this practical solution in England, and one finds experiments, of which it is useful to take account.

In the cloister of the abbey of Westminster (Fig. 34) these experiments are visible. Several vaults are closed according to the French method (see the triangle at A), and others present the projection C for the combinations of the fillings. This combination is obtained by the following procedure:- the angle  $a e f$  was bisected by the line  $a b$ , the courses of the opposite triangle have been turned perpendicular to that line  $a b$ ; Those courses of rubble then interlock on the line of the crowns; or indeed as seen at D the courses of rubble intersect that line  $a'b'$  at right angles. This is the case of the example presented in Fig. 33. Also sometimes in other vaults, notably at Ely, the courses of roughed rubble are set perpendicular to the branches of the diagonal arches as shown by the triangle G, and they always abut on the line of the crowns or are mitred. The vaults of the transverse aisle of the church of Westminster, that date from about 1230, are made according to the sketch indicated in triangle D in Fig. 33; i.e., the divisions are equal on the curve of the side arch F and on the diagonal arch O. (See perspective sketch P, Fig. 34). That arch having a greater length than the side arch, there are more divisions on the diagonal arch than on the side arch, and the slightly concave courses of rubble are inclined to that branch O of the arch. There is no transverse ridge to mark the abutting of the courses of rubble on the line of the crowns, but it already exists lengthwise from M to N as indicated in the Fig. The springing of the curve of the side arch being at R, i.e., much above the springing of the diagonal arches, there is then in  $g h i$  a vertical triangle forming a part of the load of the line  $i h$  to receive the course of rubble  $m$  (the first that begins the series of equal divisions), the constructor has erected a trapezoidal surface  $i h m n$ , warped (like the sail of a windmill). Only from the line  $m n$  were made equal divisions both on the side arch and on the branch of the diagonal arch.

It is easy to recognize that here the practitioner has had no idea other than to simplify his work by means of these equal divisions on the two arches, to place courses of rubble parallel in their extent, and thus to avoid the cutting of this rub-





rubble on the work, required by the French system. The results of the adoption of this simplifying procedure were not delayed.

The French vault has its fillings of rubble curved in all directions, concave surfaces resting their weight on stone ribs or permanent centres. Each triangle of the French vault is an independent cell maintaining itself. According to the preceding, one sees that the English constructors did not regard the triangular fillings as little vaults, but as panels, or rather as a series of centerings. In fact, admitting that one has set on the combined centres, such as the transverse, side and diagonal arches (i.e., each having their own curve) centerings of planks, it is evident that these laggings of uniform width in their entire extent would give exactly the form represented in the sketch P (Fig. 34); that these laggings could not unite parallel on the line of the crowns of the triangle, but would abut.

Did the English make vaults originally composed of stone arches or wooden curves, on which they laid planks or lagging, in brief? This is possible; the core that there still exists in England in the cloister of the cathedral of Lincoln among other examples, vaults constructed thus that date from the 14th century. One should not lose sight of the fact, that wooden structures have from all time held an important place in English architecture, as in the architecture of all the races of the North.

The system of vault compartments with triangular projections in the French vault can nowise lend itself to the use of planks or timbers, since it would have been necessary to dress each one of them to give it greater width at the middle than at the ends; while the primitive English system indicated above permits the construction in wood; more it indicates that it is a result of that. The derivatives from the preceding examples also emphasize that preoccupation of the constructors. The English vault in the 15th century comes to be a combination of carpentry rather than one of masonry.

After the 13th century the ridge ribs appeared and then the extra ribs. The ridges were an entirely natural result of the abutting of the courses of the rubble on the line of the crowns. The ridges -- at least for vaults of great span -- were required to prevent the deflection of those courses of rubble that had an inappreciable rise and thus seem to represent lagging. These planes curved in one direction, but neither concave or very lit-





little so, -- since these courses of rubble fulfilled the purpose of lagging, -- needed to be supported at the middle of their length, so as not to be deformed or deflect; the ridge ribs were then set to avoid that accident.

Soon the consequences of this principle led to combinations of arches, whose analogies are not found in France; it is always a mode of simplification, that is the cause of those combinations.

All in the domain of architecture of the middle ages is so slightly appreciated, even by architects, it must be confessed, that men hold to the appearance and judge of the methods adopted from that appearance, and do not take the trouble to examine if behind the visible form, there be a very simple procedure that directed it.

Already in 1342, one of the men in England most distinguished among architects occupying themselves with architecture, with the practical sense applied to everything in that country, Professor Willis, had published a very extended and learnedly deduced work on the construction of English vaults of the middle ages.<sup>1</sup> The work is perhaps the first serious study ever made of the system of construction of English vaults, and certainly the observations collected since have only confirmed the views of M. Willis. Yet having no point of comparison outside the English system, the learned professor could not entirely appreciate the practical side. Utilizing his remarkable work and our personal observations, we shall attempt to make it understood, how those vaults, apparently so complex, are the simplest deduction from the system, whose elementary principles we have explained.

Note 1. p. 525. This work was inserted in the first volume of the Transactions of the Institute of British Architects, and was translated in 1843 in the *Revue d'Architecture* (Vol. 4). In the introduction preceding the text of M. Willis, the translator does not emphasize the profound differences, that separate the structure of English vaults from French vaults, and does not seem to have studied the latter; but in 1843 no person was in a condition to devote himself to a critical work on this subject.

Since to prevent the flexure of the courses of rubble regarded as lagging, the English constructors had judged it necessary to establish a ridge rib in each triangle of the vaults, abut-





abutting against the ridge rib of the crowns, it was natural for them to establish several (Fig. 35).

The ribs extend from the springing to the middle of the ridges at  $a$   $a'$ . These constructors judged that for the large triangles, the spaces  $a'b$ ,  $a'c$  are still too great to admit an intermediate rib. Then they establish  $g h$ ,  $g i$ , abutting the middles of the half ridges at  $h$  and  $i$ . Never forget that each course of the French vault has its particular curve, a portion of a circle with rare exceptions. Thus in conforming to that principle, if the English constructor must adopt for each of these ribs, -- all of which have different bases, -- a special curve, it would have been necessary to draw: -- 1, the curve of the side arch  $g b$ ; 2, those of the two ribs  $g a'$  and  $g a$ ; 3, that of the diagonal rib  $g c$ ; 4, those of the two additional ribs  $g h$ ,  $g i$ ; 5, that of the transverse arch  $g l$ ; seven curves in all. Further, admitting as in the French vault, that all these arches were parts of a circle, it would either have been necessary to place their imposts at very different levels, or that the crowns of these arches must themselves be at very different levels. In the first case there existed between the capital of the pier and the springing of the curve of the ribs having the least base, a vertical interfering with placing the rubble fillings according to the mode adopted by the English; the vault along the side aisle seems no longer to belong to the construction but to be detached as may be seen in some of these primitive vaults, notably in the choirs of the cathedrals of Ely and of Lincoln. To avoid that inconvenience, from the end of the 13<sup>th</sup> century the English constructors adopted a compound curve, so that all those curves start from the level of the capital of the pier and have the same radius.

Thus (Fig. 35) the diagonal arch being the longest curve, it is drawn by means of a first circular arc  $g'm$ , then a second circular arc  $m n$ , the point  $n$  being fixed as the height of the vault under the crown. It is well understood, that the centre of this second curve is found on an extension of the line passing through the point  $m$  and the centre  $e$  of the arc  $g'm$ . The curve of the side arch  $g o g'$  is given by the same radius  $e m$ . this being done, all the curves of the other ribs are given. All have a base shorter than that of the diagonal rib. Then projecting the rib  $g'h$  on the line  $g'c$  of the base; erecting





a perpendicular from this point  $h'$ , it will cut at  $h''$  the master curve  $g'n$ . The curve of this rib will then be the curve  $g'h''$ . Projecting the rib  $g'a'$  likewise to  $a'$ ; erecting a perpendicular at that point, it cuts the master curve at  $a''$ . The curve of this rib will then be the curve  $g'a''$ . Projecting the second rib  $g'i$  to  $i'$ , erecting a perpendicular at that point, it cuts the master curve at  $i''$ . The curve of the second rib will then be the curve  $g'i''$ . Proceed the same for the rib  $g'a$  of the long triangle, whose curve is given by  $g'p$ ; also the same for the transverse arch, whose curve will be  $g'g$ .

These crowns all attain different levels. To draw the transverse ribs  $c b$ , it will suffice to erect perpendiculars from the points  $h, a', i, c$ , on the line  $c b$  (horizontal projection of this transverse rib), and to take on these perpendiculars distances equal to  $h'h'', a'a'', i'i''$  and  $c n$ , which give the points  $r, s, t, u$ , of the intersection of the ribs with the transverse rib  $c b$ . If one desires the side arch to have the same curve as  $a$ , the other arches, he will proceed as before. We project the line  $g'b$  on the base  $g'o$ ; from the point  $V$  we erect a perpendicular to cut the master curve at  $V''$ , giving the curve  $g'V''$  of the side rib. This curve in transverse projection will give the height  $b'V''$ , while the side rib, revolved in  $g'o$ , will give the height  $b'o'$ . Employing the same method of drawing, we shall have in any the longitudinal projection of the branches of the ribs.

All that is only very elementary descriptive geometry, and demands no great effort of intelligence on the part of the draftsman, but the consequences are important from the point of view of the construction. First, since we have only a single compound curve for all the ribs; or rather all the ribs are only longer or shorter segments of the same compound curve, the template for cutting one rib serves for all the ribs; further, the ribs in swinging around the vertical erected in the axis of the pier  $g$ , must necessarily pass through the same curved surface, since all have the same curve, giving to the extrados a concave conoidal form like the bell of the trumpet, which singularly simplifies the setting of the rubble of the fillings. So much (Fig. 36) that in drawing the horizontal projection of this vault, one sees how easily can be set the courses of rubble fulfilling only the functions of planks or boards placed



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 (99) ninety-ninth is the fact that the  
 (100) hundredth is the fact that the

between the ribs of carpentry. But the series of logical deductions, that had brought English constructors to these multiplied arches as ribs of carpentry, led them (because of the small curvature of these ribs, in the upper part of the vault) to connect them by bosses and cross ribs, as indicated in Fig. 36.<sup>1</sup> The intersections of the cross ribs with the ribs give motives for bosses, that also strengthen the junctions. Thus one obtains a resistant network of ribs strongly braced, on which can be placed the rubble filling as one lays planks on a framework of carpentry. Fig. 37 gives the perspective sketch of one of those bosses (A in Fig. 36). The cross ribs are drawn in a vertical plane, as indicated in the section B (Fig. 37), rebates F being made for setting the rubble filling, the tops of these ribs being flush with the extrados of this rubble. One notes that the rib C (here the diagonal rib) has at D a band much wider below the cross rib than at d, caused by the vertical position of that cross rib, and which is perfectly according to the conditions of resistance of these ribs, that no longer require as much strength where they join the framework as where they are below it. Returning to Fig. 36, we see that the bosses A, B, C, are set in a circle with its centre D; so that the branches D C, D A, D B, of the ribs are identical. The bosses E, C, F, divide the branch of the transverse rib into four equal parts, as the boss G divides the longitudinal rib into two equal parts. The boss H divides the branch A O into two equal parts, and to place the boss I, the points B, H, A, K, are joined by lines, as one sees at M. These two lines cut the rib at two points a and b; bisecting that distance a b is marked the point P, centre of the base I.

Note 1.p.528. Hall near the cathedral of Ely, north side, 14<sup>th</sup> century.

Multiplying thus the arches of vaults intended to support the fillings, that are only stone panels, it was natural to construct these arches themselves entirely different from the arches of French vaults.

The arches of French vaults are properly turned with voussoirs having small thickness between their beds, i.e., that in an arch of a French vault, the constructor has multiplied the joints, so as to leave to that arch a greater elasticity, to avoid the effects of fractures, that would have been a cause of





dislocation of the vaults. Although those panels themselves retain a certain elasticity, it was important to preserve from sensible deformation the permanent centres (arches) that support them. By turning these arches with thin voussoirs and multiplying the joints, the French constructor considered with much justice (that admitting movement and deflection), the multiplicity of the always thick joints, allowed the arch to follow these movements or settlements without deforming its curvature. But from the instant that the English filled the spaces with stone panels, and that they adopted curves composed of two segments of circles, one of which had a very great radius, it would have been dangerous to turn these arches with thin voussoirs. Thus when the English vaults are made according to the drawings just given in the last place, on the contrary the arches are composed of long pieces of stone as would be carpentry curves. The ribs or cross ribs, which are struts, are often cut in one piece of stone from one boss to another. This method was a result of the system of vaults adopted by these constructors of the end of the 13th century.

From all the preceding it results that the English constructors, in spite of the apparent simplicity of these Figs., on the contrary adopted a simplifying procedure, both for drawing vaults and for their construction. It is interesting to observe how our neighbors were already permeated by that practical spirit, that tends to converge common efforts to one aim, leaving little to individual initiative. It is evident that to build a French vault at the same epoch, i.e., during the first half of the 14th century, it required on the part of each workman more intelligence and initiative, than was necessary to construct a vault like that just analyzed. The diagram made according to the last method, the need for workmen to restrict themselves to a sort of mechanical work. It was then not so with our vaults, which required during the setting of the combinations, that the master must direct step by step, but could not draw generally, that the mason could only execute by an effort of his intelligence. We believe that there is more art in our vaults, so simple in appearance, than one could find in a purely geometrical system, very simple as a practical procedure, but so complicated in appearance. The geniuses of the two peoples thus show themselves on both sides with their qualities and their defects.





Yet one is not surprised that men who already possessed a collective and simplifying spirit so manifest, were equally permeated by that feeling of discipline and of order, that was so fatal to us on the days of Crecy and of Poitiers. All holds together in the history of a people, when one desires to see it closely, and this is what makes the study of the art of architecture of those times, so entirely impressed by the genius of the peoples that practised it in France and England, an inexhaustible subject of interesting observation.

We have seen in Fig. 35 how the English constructors, having adopted a single compound curve for all the arches of a vault, even sometime applying this curve to the side arch, and consequently to the archivolt of the window opened beneath that side arch. This is a simplifying procedure in the construction of vaults, that requires only a single diagram for all the arches, and which explains why many of those archivolts of windows belonging to edifices vaulted in the 14<sup>th</sup> century are obtained by means of compound curves. In this form observed by all those that have visited England, there is not a caprice or question of taste, but the rigorous application of a system followed, as we have just demonstrated, with a mind rigorously methodical in its deductions. Once the curve was accepted from the necessity of construction, men accustomed themselves to it, and used it in circumstances not required by the system of construction.

Yet the English constructors did not adhere to the vault, that we have just given (Figs. 35, 36): they claimed at about the same epoch, i.e., about the beginning of the 14<sup>th</sup> century, to have with arches formed of compound curves, ribs on a horizontal plane and no longer inclined to the side and transverse arches. Here (Fig. 38) is how they undertook to arrive at that result. Let A B C D be a quarter of the cross vault, one rib being drawn at A E. For the springings of all these arches, i.e., of the side arch A B, the rib A E, the diagonal rib A D, and all the other arches, if one pleases to trace others, as in the preceding example of a single arch A F has been drawn with centre o. Projecting the length of each arch on the line A C regarded as base, and erecting perpendiculars to the base, from these projected points, the line a b being regarded as the level to which each arch must attain, and one draws the segments F a, F g, taking their centres at m and n on the line F o prolonged; the segment I h with centre r on the line I o prolonged; the





segment  $Kb$  with centre  $q$  on the line  $Ko$  prolonged. The crowns of all these arches are in the same level plane, and consequently the ribs  $CD$ ,  $CB$  are horizontal. Yet the impostes of these arches all have the same curve, at least to the point  $K$ , that avoids the difficulty where the curves are different. Once this level  $K$  is passed, there is so little difference in the curvatures of these arches, that the courses of rubble filling can always be set according to the method indicated before.

Let us see (Fig. 39) how this system of construction of English vaults inclines to a method more and more mechanical. Let  $ABCD$  be a quarter of a square vault, and  $EFGH$  a quarter of a rectangular vault. In the first the diagonal arch is the arch  $AD$ ; in the second the diagonal arch is the arch  $EG$ . Having admitted as shown in Fig. 36, that the ribs must be multiplied, so as only to regard the fillings as panels, no longer as little vaults, it naturally follows that these panels must be of similar extent, as far as possible. To draw the ribs, the ridges will no longer be divided in equal parts as in Fig. 36, but we describe the quadrant  $BC$  for the quarter of the square vault, and divide this quadrant in equal parts. Drawing the lines  $Aa$ ,  $Ab$ ,  $Ac$ , through the dividing points, we shall have the horizontal projection of the ribs of one eighth of the vault. Hence the angles  $DAAa$  ( $A$  being vertex),  $aAB$ ,  $cAC$ , will be equal, and the panels comprised between their sides are similar. We brace these ribs by the cross ribs,  $e$ ,  $f$ ,  $g$ ,  $h$ , as in Fig. 36, but so drawn here that their junctions are found on the quadrants  $BC$  and  $ei$ . Either we wish to adopt for all these ribs a single and even a compound curve, as in Fig. 35, or we desire that the ribs  $BD$ ,  $DC$ , be level. In the first case we take the diagonal rib  $AD$  as being largest, we project it on the line  $A'D'$ , erect the perpendicular  $D'D''$  ( $D''$  being the height of the vault under the crown), and we draw by means of two centres the compound curve  $A'D''$ . Proceeding as stated above; taking the lengths  $Aa$ ,  $Ab$ ,  $Ac$ ,  $AC$ , and transferring them to the line  $A'D'$  at  $A'a'$ ,  $A'b'$ ,  $A'c'$ ,  $A'C'$ , and from these points  $a'$ ,  $b'$ ,  $c'$ ,  $C'$ , erecting perpendiculars to the line  $A'D'$ , these perpendiculars cut the curve  $A'D''$  at points which give the heights beneath the crown for each of the ribs  $Aa$ ,  $Ab$ , etc., and consequently for the rib  $DC$  the vertical projection  $C''D''$ . But if we claim to place these cross ribs level, it is necessary for



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us to seek the curves  $A'K$ ,  $A'l$ , etc. by means of procedures indicated in Fig. 38, always retaining for the imposts the same curve  $A'n$ .

If it concerns a rectangular vault, whose quarter is  $EBFG$ , we proceed in exactly the same manner as for the square vault; only the side rib  $EF$  and the ribs joining this side arch being much shorter than the side arch and ribs  $Aa$ ,  $Ab$ ,  $Ac$  of the square vault, the crowns of these ribs will be lower (assuming that we adopt only a single curve) than in the square vault, i.e., that the high points of these curves will be at  $m$  for the side arch  $EF$ , at  $o$  for the rib  $EO'$ , at  $p$  for the rib  $EP'$ , at  $q$  for the rib  $EQ'$ , etc., and that the line of the ridge  $FG$  will give the vertical projection  $F'D''$ . But if we desire the ribs of this rectangular vault to be level, then it will be necessary to seek compound curves as above, and the curve of the side arch  $EF$  revolved at  $A-I$  will always retain a part of the lower primitive curve from  $A'$  to  $s$  for the imposts.

Thus one sees how are given, by the application of a principle of construction rigorously deduced, those lowest arcs  $A'I$  or depressed compound arcs  $Am$ , so frequently adopted for the windows of English vaulted naves, those windows being circumstribed by the side arch. Yet for those curves generated quite naturally by a procedure of construction, men have desired to find more absurd origins. Those curves pretend to imitate the mitre of a bishop, in indeed they have a mystical-symbolical signification; in approaching the straight line above a certain point, they should indicate the disposition of the Christian soul that becomes stronger as it rises toward heaven! But we shall not report those dreams of so many authors, that have written on the architecture of the middle ages without having at their service the first elements of geometry and of statics. It is clear that artists who are wearied by all reasoning, and that would be easy if all reasoning were forbidden, even in architecture, by a good and well made law, and in particular if religiously applied, and who are earnest in repeating these puerilities concerning Gothic construction, and prefer rather to see the imitation of the mitre of the bishop in a curve than a principle of construction; in this case the mitre of a bishop or the aspiration of the soul dispenses with all study and all discussion, and the Gothic vault thus passes into the account of human nonsense;



While the river is in its highest stage, it is a
 very different thing from what it is at low
 water. It is then a broad, shallow, muddy
 stream, and it is not until it has reached
 the mouth of the river that it becomes a
 deep, narrow, swift-running river. The
 river is then a very different thing from
 what it is at low water. It is then a
 broad, shallow, muddy stream, and it is
 not until it has reached the mouth of the
 river that it becomes a deep, narrow,
 swift-running river. The river is then a
 very different thing from what it is at
 low water. It is then a broad, shallow,
 muddy stream, and it is not until it has
 reached the mouth of the river that it
 becomes a deep, narrow, swift-running
 river.

which simplifies the question. When a single curve serves for all the ribs of a vault, and if these arcs rotate around the supporting pier, it is clear that above each pier, each part of the vault will give exactly the form of the bell of a trumpet. <sup>1</sup> When the upper part of these compound curves is alone modified, so as to set all the crowns and ribs level or in the same horizontal plane, the bell form no less exists to a certain height above the springings, and the variety of the upper curves modifies slightly the form of the bell, but cannot destroy it to the eye. It is also clear, because of the adoption of these radiating ribs with equal angles between them, whatever the arrangement of the bays, square or rectangular, that the architects must abandon the diagonal arch, and give to all those radiating ribs fulfilling a similar function, a similar section. That is what occurred. It was according to the logical advance of the procedures adopted by English constructors, no longer to place between these ribs courses of rubble, but to replace them with slabs, actual stone panels. This system was adopted on the other side of the Channel from the 15th century, both on ribs arranged like the bell of the trumpet, and on ribs forming a series of curvilinear pyramids with a part of a tunnel vault. Thus was constructed the vault of the chapel of S. George at Windsor. <sup>2</sup> Fig. 40 shows the extrados of one of those pyramids; how are arranged the ribs and rebated ribs A, and how the filling panels B fit in these grooves. The ribs comprised between the diagonal ribs O and in the level line D D'. From this line to the line C C' of the crowns, the vault forms a tunnel vault composed of stone panels with radial joints, bearing in relief compartments there imitating intersections of groin ribs, ribs and cross ribs etc. The line of the crowns or the rib that connects the crown E of the side arch with the line D D' is horizontal, so that the ribs between the diagonal ribs O and the side arches are cut on different curves; likewise for the ribs comprised between the diagonal ribs, according to the method previously indicated. Thus in this vault of the chapel of Windsor, several systems have been employed; the system of vaults as portions of curvilinear pyramids, with ribs made on different curves (except for the imposts); the system of long voussoirs of small width, like slabs with radial joints, completing the vault by a tunnel vault in its upper part. Also later





the ribs are suppressed and the English vaults only consist of masonry in large slabs with ribs projecting below and cut in their mass, still imitating the structural arches that no longer exist in fact. Thus are constructed the more recent vaults of the cathedral of Peterborough, and those of the chapel of Henry VII at Westminster.

Note 1.p.535. To this form has been given the name of *fon vault*; but *o fon* extends in a single plane; it is unnecessary to emphasize the lack of precision in that name.

Note 2.p.535. See the Memoir of Professor Wittis; On English Vaults of the Middle Ages, or in Vol. IV of M. Doly's *Revue d'Architecture*, the translation of that work with the plates.

Those kinds of vaults are very flat. Thus the vault whose extrados is presented by Fig. 40 has only a rise of a little more than one fourth its span. That alone indicates the advantages which one could derive from this mode of construction.

We have believed it necessary to enlarge somewhat on the combinations introduced by the English constructors in the forms of vaults so different from ours in appearance, although starting from the same principle. This digression tends to demonstrate, that from the same principle, when followed systematically, can proceed very varied deductions. It is certain that from the generating principle of the Gothic vault can be derived yet a other results, that consequently there can be no good reason to reject this principle, excellent in itself, and leaving to the architect the greatest liberty in applications that can be made, according to the programmes, resources, nature of the materials and economy.

Let us return to the French vault. We left it at the moment, when having reached its development, it allowed the covering of all possible surfaces by the aid of arches or permanent centres supporting little vaults of roughed rubble. Having reached at the middle of the 13<sup>th</sup> century a degree of absolute perfection, according to the method accepted from the middle of the 12<sup>th</sup> century, the French system is no longer modified; it always proceeds from the transverse arch, the diagonal and side arches with or without additional ribs. It is only in the more northern provinces, and notably in Normandy itself, that the use of additional ribs became frequent after the end of the 13<sup>th</sup> century. In Ile-de-France, Champagne and Burgundy, the con-





constructors adhered to the diagonal and transverse arches until the end of the 15<sup>th</sup> century. From this point of view as a procedure in construction, the French vault was not modified. The improvements or innovations -- if one can term innovation the logical consequence of a system first adopted, -- only concern the springings of these vaults. We have seen that in England by means of compound curves men avoided the difficulties resulting from curves of different radii for turning the fillings, since in these English vaults after the 14<sup>th</sup> century, the lower curve is the same for all arches of the vault. In France with very rare exceptions, which belong to an epoch relatively recent, the compound curve is not employed, the side, transverse and diagonal arches each having their curve, which is always a circular arc. As men felt more and more the necessity of placing the crowns of those arches at the same level, so as not to lose space and to be able to pass the tiebeams of the carpentry directly above the extrados of the vaults, when these arches had very different spans, it was necessary either that their junctions should have very different angles, i.e., some very acute and others very obtuse, or that the springings of those should be placed at different levels.<sup>1</sup> The last method prevailed, for the constructors sought to give to the pointed arches of the same edifice -- at least for the transverse and side arches, and the archivolts, angles at the crowns not too unequal. The springings of these different arches were one of their greatest difficulties.

Note 1.p.538. On this subject, see Art. Construction, Chapter Voute.

The choir of the cathedral of Narbonne, commenced at the end of the 13<sup>th</sup> century and evidently conceived by a very skilful master, presents precious data in relation to the construction of the vaults.<sup>2</sup> The last pier of the bays parallel to the axis of the choir, that commences the radiating bays, is arranged rigorously and the most economically possible to receive the arches it must support. Fig. 41 gives the horizontal section of this pier below the vaults of the side aisle. The archivolt of the part parallel to the axis of the choir occupies the entire width  $a\ b$ , and that of the first curved bay of the same width  $a'\ b'$ . This archivolt has the entire thickness of the pier within some inches. The little column C rises to the high vault





to bear a single arch (Art. Cathédrale, Fig. 43), since we are in the curved part of the choir; the little column D supports at once the transverse arch A and the two diagonal arches of the curved side aisle. The bays T being narrower than those T' parallel to the main axis, it results that the vertical rib G, that receives the principal round G" of the archivolt, finds itself in the curved bay T behind the face H and does not appear. These are the arches that rigorously gave the positions of the ribs and little columns of the cylindrical pier. If we show the vault of the side aisle (Fig. 42) with one of the piers of the curved portion, we see how the archivolts penetrate into the pier, and how the transverse and diagonal arches of the side aisle, because of their greater spans, have their springings placed below those of the archivolts. We see how are drawn those diagonal arches according to a curve in their horizontal plane. Fig. 43 explains this drawing. At A are the great piers of the sanctuary; at B are the entrance piers of the chapels. The crowns C of the diagonal arches are placed at the middle of the line a b of the crown of the little filling vaults, that connects the top of the transverse arch at the entrance of the chapels with the top of the archivolt. So as not to have too acute an angle at e, the constructor has given in horizontal projection a curvature to the diagonal architrave C. Thus the fillings are more equally established in the two adjacent triangles having as bases the transverse arch of the side aisle and the transverse arch of the entrance to the chapels. At the cathedral of Bourges, the vaults of the side aisles of the choir (about 1225) are already drawn on that principle.

Note 2.p.538. Art. Cathédrale, Fig. 48. The cathedral of Norbonne is singularly poor in sculptures. It seems that the master of the work concentrated all his resources to obtain a construction irreproachable in conception and execution.

But we see in the perspective of Fig. 42, that before the diagonal arch and the archivolt the filling is abandoned and even penetrates the pier itself, continuing above the ring forming a capitol. There is an incomplete point, for the filling vaults must always rest on the extrados of the arches. In the 14th century, the constructor of the abbey church of S. Ouen of Rouen takes a franker and more logical method, although more complicated in appearance (Fig. 44). The archivolts occupy the





entire space a b, i.e., exactly the width of the pier less the rib C, intended to receive the transverse and diagonal arches of the high vaults, and the profile of these archivolts is only that of the pier, or to be more exact, the section of the pier is only the section of the archivolt. The transverse arch of the side aisle is likewise only the profile of the pier, and the diagonal arch has the profile h. In elevation these arches penetrate each other as indicated by the perspective view. There is no longer a capital, since there is no reason for it, and the imposts with horizontal beds rise to the level N, i.e., much above the springings of the arches.

This is the final expression of the combinations of the springings of the arches of vaults in France, and this system was followed until the epoch of the Renaissance. These are rigorous consequences of the principle of the vault discovered in the 12th century; but as for the mode of construction, it does not vary, i.e., the arches always fulfil the functions of permanent centres receiving little filling vaults between their branches, little vaults that never become panels, but are constructed of little voussoirs with curved courses always starting from the transverse, side arch, or archivolt, to rest askew at the other end on the diagonal arches.

In Art. Construction it is stated how by the aid of this system of vaults, one can cover all surfaces, however irregular they may be; how one can make skew, rampant or warped vaults without difficulties in jointing, etc. This French system is thus essentially practical; it presents an improvement on the Roman system, and consequently it was more reasonable to improve it further, than to abandon it and resort to the Roman method. But the infatuation of the 16th century for the Italian arts among us vanquished the reasons that militated in favor of our system of French vaults, from which it was easy to derive results more and more extensive. Philibert de l'Orme in his *Traite d'architecture*,<sup>1</sup> expresses himself on the subject of these vaults: - "Those forms of vaults have been found very beautiful, and are seen well executed and constructed in various places in the kingdom, notably in this city of Paris, as also in several others. Today those having some knowledge of true architecture no longer follow this fashion of vaulting, called by workmen the French method, that truly I cannot scorn,





but rather confess that it has been made and practised in very good and difficult designs. But forasmuch that fashion requires great expense, i.e., great strength to abut it and make the flying buttresses, so as to hold the work firm, as one sees in the great churches, at the end of this present chapter, I shall describe a vault with its supports, such as you can see under the form of a perfect square, as large on one side as on the other, where you will note the crossing of the diagonal arches, etc." Thus whatever can be claimed by the more or less official criticisms of our Academie des Beaux Arts, still in the 16th century those vaults were regarded as French (by workmen, it is true; but in the matter of traditions the language of workmen is most certain). Now as the architecture of the middle ages is derived in great part from the system of vaults, it is necessary to take its part, and admit that we had an architecture recognized as French from the 12th to the 15th centuries. But the text of Philibert de l'Orme is interesting for more than one reason. Our author admits that those having some "knowledge of true architecture no longer follow that fashion of vaulting," and the first example that he gives of a vault suitable to cover a vast nave, after that preamble, is a Gothic vault with diagonal arches on a square plan with ridges and ribs. As for the examples that he furnishes "at the end of his chapter," those are traces of spherical vaults penetrated by a rectangular plan, vaults that cannot be made of great dimensions, which are difficult in jointing and expensive, are very heavy, and thrust much more than Gothic vaults. And in fact until the beginning of the 17th century, French constructors, whatever "knowledge" that they had "of true architecture," continued to build vaults over wide naves on transverse and diagonal arches; the church of S. Eustache at Paris is the proof of this, and it is not the sole example. Practice was then stronger than theories on "the true architecture," and having found nothing better, they continued to employ the old method until the moment -- and that under Louis XIV alone -- when were adopted for great naves stone tunnel vaults with penetrations, as at S. Rich of Paris, the chapel of Versailles, the nave of the Invalids, etc.

Note 1.p.543. L'Architecture of Philibert de l'Orme. Paris. 1578. Book IV. Chap. 8.

Now this sort of vaults is a step backward, not an advance.





Tunnel vaults have a continuous thrust not concentrated at isolated points: they are very heavy if of stone; their effect is not happy, and the penetrations of the openings in their sides produce very disagreeable curves, that the Romans justly avoided when they could.

One then sees appear in the naive text of the good Philebert de l'Orme this feeling of rejection, though with regard to the procedures of the middle ages, which has been developed since him with less good nature. In fact in the margin of the text just cited, there is stated as a guard:- "The author approves the modern fashion (de l'Orme so designates Gothic vaults) of vaults, always not desiring to use them." Why, since he approves them? He does not say. Whatever this may be and why he would not use them, he constructed cross vaults like all his colleagues, and he was right, for most of the examples that he gives contain novelties, that are neither practical nor serious, if it concerns the covering of great spaces. In that Philibert de l'Orme preludes the criticism of the construction of the middle ages (if we can give this name to irrational reproach.). Since him that criticism reasons no better, although less naive; but it is still more exclusive, and in speaking of the fashion of vaults of the middle ages does not say, "which truly I cannot disdain, but rather confess that men have made and used very good and difficult designs." Those things are no longer admitted in the 19th century, because the logical minds of our time could reply:- "If you confess that the system is good, why do you not use it?" Better say nothing or beat the water, than to raise such questions.

Whatever Philibert de l'Orme says of it, the Renaissance then does not change the system of vaults for great naves, because it would complicate this system. It multiplied the secondary members rather as a motive of decoration than to obtain more stability. In fact the vaults that it built are in a very bad state or even have fallen, while the duration of the vaults of the cathedrals of Chartres, Rheims or Amiens, will yet defy many centuries. The high vaults of the church of S. Eustache of Paris were only built during the last years of the 16th century, and are not very stable; their imposts are not skilfully combined, the arches are turned with stones of unequal height between beds, which is one cause of deformations, as previously





stated. Among those vaults dating from the 16<sup>th</sup> century may be cited as remarkable, those covering the choir of the church of S. Florentin, and which date from the middle of that century. <sup>1</sup>

Note 1.p.344. The flying buttresses that abut those vaults are badly combined, as occurs to nearly all flying buttresses of that epoch; then the external surfaces of the buttresses have been undermined at various times; some settlements were produced. Twenty years since, those vaults threatened ruin and it was necessary to rebuild them. M. Pieplu, architect of the department of the Yonne executed this work with much skill several years since; but for reasons of economy, they were satisfied with simple cross vaults. We give here the old ones, drawn before the demolition.

We give (Fig. 45) the horizontal projection of half of these vaults with the apse of the church. The transverse and diagonal arches form the principal skeleton of the structure, as in the vault of the middle ages; but the ribs extending from the pier to join the middle of the ridge no longer exist here, and are replaced by intermediate ribs a b, that produce a piquant ornamental effect, yet are wrong in transferring a lateral thrust to the sides of the side arches, which is absolutely contrary to the principle of the construction of Gothic vaults, and to good sense, which is worse. That thrust is also increased by the ribs a d, which themselves abut the ridges d e. So those side arches (revolved into A A'B) were inclined to the exterior under the pressure of those arches that push them at a'a", which would not have occurred, if instead of those ribs a b the architect had placed diagonals A d; but they would not have had this compartment in star form, and the desire to produce a novel appearance overcame the reason directed. One sees then that already is manifested this tendency, now so developed in architecture, to sacrifice the true, the wise and the reasoned, to a form resulting from the caprice of the artist. Many other shocks to reason are found in this vault. Thus we have revolved the transverse arch A C and the diagonal arch to A F; the great arch A D abutting the crown of the chevet to A G. The junction of this great arch A D with the diagonal arch gives the crown H; now as this diagonal arch is drawn, the level of this crown H is given and is found at h. We transfer that level to h' on the revolution of the arch A D. The level of the crown





I is given; it is the same as that of the crown H, since the diagonal arch A E is drawn. Then it is necessary for the arch K I to attain that level I; we revolve it to K L i, the rise I i being equal to the line I h. Revolving on the circular arc the crown O, we obtain the point o', and the height O o' gives on the curve K i as well as on that of the great arch A D, the level of the crown O at O' and at o". Then it is necessary for that great abutting curve A D to pass through G, h' and o". From o" to G i h evidently approaches the horizontal too nearly, and badly abuts the junction of the diagonal arches and ridges of the chevet; so that branch of the arch o"G was twisted and raised, because the great transverse arch K L was deformed.

The crown B being given in horizontal projection, its level is given at b' on the revolution of the arch; the junction a on the side arch being given in horizontal projection, its level is given at a" on the revolution of the side arch, and then the length a b in horizontal projection; the arch a"b" is known. It is the same for the arch b n, revolved to b"m', since the level of the crown m is known.

As for the ridges d e, they are taken on a circular arc, joining the crown B of the side arch to the crown e of the diagonal arches. That arch of the ridge is revolved from n to e, n giving the level of the crown B of the side arch in relation to the level of the crown e of the diagonal arches. At M are revolved the diagonal arches p q of the chevet (the level of the crown being that of the transverse arch), the branches of the ribs in r q and the ridges in p s. All these arches, ribs, false ribs, false ridges, are placed in a vertical plane, whatever their position in relation to the curvature of the principal arches (see at P).

But the secondary arches intersect more or less obliquely the principal arches, according as those approach or leave the vertical, and the sides of those secondary arches being set in a vertical plane, one is found above and the other below the extrados of the principal arch; there resulted from this a difficulty in building the compartments. To avoid that difficulty, the architects of the Renaissance designed a pendant boss at those junction points (Fig. 46); <sup>1</sup> a pendant boss composed of a cylindrical body penetrated by these different arches. <sup>2</sup> Like the principal arches, the secondary arches being placed in





a vertical plane, the extrados of the false rib A strikes horizontally against the cylindrical body, while the extrados of the diagonal arch B penetrates at b on the side next its springing, and at c on the side next its crown; then there will be a difference of level between the point b and the point c. And from b to c, how to set the rubble filling? The constructors then increased the height of the sides of the principal arches on coming near these bosses as indicated by the addition g to reach the point e, this because of the levels of these junction points of the ribs, false ribs and false ridges. For example, there would be a difference at h at the junction of the diagonal arch B, since the extrados of the false rib l does not reach the level of the false ridge A. One sees what complications in cutting are produced by those caprices of the architects of the Renaissance, much more occupied in obtaining an ornamental effect than by the traditions of wise construction. If we add to those difficulties gratuitously accumulated, the lack of knowledge of geometrical drawing, that already made itself felt in the workyards, we shall not be surprised by the brief duration of these vaults of the 16<sup>th</sup> century. Still one recognizes that the habit of reasoning on the application of forms suitable for the purpose is not yet lost among the masters. Thus the elongated shape of these pendant bosses is indeed produced by these penetrations of arches at different levels. These long stones that seem to the eye to be pegs placed at the intersections of arches, are not there by a caprice of the artist, but by a necessity of construction, and the pendants more or less ornamented by sculptures that the artists gave them below the arches, only emphasize the function of these bosses at the junctions of arches.

From the point of view of construction, the art of the 16<sup>th</sup> century was in a state of inferiority to the preceding arts, for the vaults as for the rest. For example, the flying buttresses at that epoch are no longer arranged according to the laws of statics and of equilibrium of forces (Art. Arc-Boutant); the archivolts no longer have regularly cut extradosses, the beds of the courses no longer correspond to the architectural members; the openings of the tracery adopt forms contrary to the nature and resistance of the materials employed. It is evident that the architects first of all are occupied in applying





certain forms belonging to a mode of construction differing from that adopted in France in relation to the materials and their judicious use, abandoning to subordinate hands the drawing of that masonry, which is not in accord with these forms borrowed elsewhere. The masters of the 15 th century being better constructors, practitioners and draftsmen, than those of the 16 th; those of the 14 th excelled those of the 15 th, and those of the 13 th were perhaps still better than those of the 14 th. Yet the detailers of the 16 th century were geniuses, if we compare them to those of the 17 th century, for there is no ruder and more badly drawn structures in France, than those of the 17 th century, unless we return to the worst epoch of the Romanesque school, and yet men compel themselves to imitate them today.

French and English vaults both started from the same point in the 12 th century, but in both countries had reached very different results in the 16 th, that give an accurate measure of the aptitudes of the two peoples. According to what we have already seen, one will observe that in perfecting themselves according to the method adopted after the 13 th century, the English vaults, in spite of their apparent complexity, had reached in both countries very different results, in that one curve could suffice for all the arches of a vault, or that (if these curves must reach a crown at the same level), the curves differ only in one part of their development, and are drawn by a very simple procedure; that all those arches remain independent, and are only connected by ribs in a single piece, that have only a secondary purpose, and cannot influence in any wise the principal curve adopted for the arches; that the fillings are no more than panels, as easy to draw as to set. In French vaults we see that their constructors multiply the arches; then cross them so that the curvatures of these arches must differ for each one; that the curvatures are determined by the levels given by the preliminary drawing on the horizontal plane; that those arches are dependent on each other, and that consequently those constructors are no longer masters, to give these curves the rises necessary for their functions, their resistance or their effect in thrust and abutting; that in a word, these French constructors abandon the judicious and perfectly understood system (that of the 13 th century), to enter on combina-





combinations indicated only by caprice. The framework of the English vault of the end of the 15<sup>th</sup> century is solid and systematic; it is the result of long experience faithful to the principle adopted. The framework of the French vault in the 16<sup>th</sup> century is <sup>not</sup> solid, because the arches intersect according to a caprice of the artist without necessity of reason, and act differently, some being inert and weak, others active and strong. Instead of rendering the French cross vault more stable than it was, by the addition of all these secondary arches, the French architects alter it and take away its properties of elasticity, strength and freedom. Thus these vaults of the 16<sup>th</sup> century mostly approach their ruin, when they have not already fallen.

Then in the 16<sup>th</sup> century our architects sought by the aid of mediocre knowledge to make surprising things, and in spite of his rare merit, Philibert de l'Orme himself is not free from this caprice. Pedantry is introduced into art, true and practical knowledge is lacking. Men desire to forget, and do forget the old methods, principles based on long experience; methods and principles that could be perfected without adopting puerile and very superficial theories. It is not doubtful, by only examining the existing monuments, that the masters of the 13<sup>th</sup> century knew geometry, and understood its applications in particular, much better than the masters of the 16<sup>th</sup> century. But the former did not amuse themselves in showing this, they employed the science like true scientists as they were, as a means and not to make a parade of it. The architects of the Renaissance already took the means for the end; and as always happens in such cases, there was a class of speculative theorists, tolerably pedantic, and behind it a compact mass ignorant of the simplest procedures. In the 16<sup>th</sup> century were made books in which were discussed Vitruvius well or badly, where were given the proportions of the orders, and where pages were covered by sketches intended to dazzle the vulgar, but men tended to construct very badly and rudely in a country where the art of construction had attained a prodigious development, first as a science and then as a reasoned use of materials and their properties. Art escaped from the hands of the people, from those guilds of artisans, to become the property of a sort of aristocracy and less understood, because it left



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aside the principles derived from the genius itself of our country, for a sort of empirical formula, unexplained and inexplicable like a revelation. It was evident that all who could attempt to discuss this formula presented as a dogma, must be repulsed by that aristocratic body of new masters, whose doctrines are still pursued today more rigorously than ever by the Academie des Beaux Arts. That is why we see at various times, there escapes from its most enthusiastic adepts a protest against the study of our French art of the middle ages, and of extended applications that could be made of it. That is also why we do not, and never will, cease to endeavor to develop this study, to cause its applications to be shown, well convinced of that truth affirmed by history; that bodies are never more exclusive than in the days when they feel their power shaken.

YMAGERIE. See Art. Sculpture.

YRAIGNE. (Old Word).

Panel of wirework. (Art. Grillage).

YRE. (Old word). Court. Area.

ZIGZAG. Art. Batons rompus. (Chevrons).

ZODIAQUE. Zodiac.

Zone of the ether that the sun seems to pass through in the space of a year, and whose ecliptic is the median line. No one is ignorant that the zodiacal zone was divided into 12 parts from the highest antiquity, one for each month, each of those parts bearing a sign called the signs of the zodiac. Those signs of the Ram (March), Bull (April), Twins (May), Crab (June), Lion (July), Virgin (August), Balance (September), Scorpion (October), Archer (November), Aquarius (December), Capricorn (January), and Fishes (February). Those figures corresponding to the months of the year are frequently represented on our monuments of the middle ages, and opposite them are represented the labors or occupations of men during each of those months.

After the 11 th century the portals of our churches have zodiacs carved on their archivolts of the doorways.

Our great cathedrals of the 12 th and 13 th centuries are all



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provided with these signs, always sculptured in a very visible manner.

At the principal portal of the abbey church of Vezelay (first years of the 12 th century), the band of medallions surrounding the great tympanum representing Christ and the 12 apostles, contains the 12 signs of the zodiac alternated with the corresponding labors of the months. This zodiac is one of the most complete that we know. The right doorway of the facade of the abbey church of S. Denis still exhibits on its jambs some subjects and signs of the zodiac, that might be complete, but has been partly destroyed. In that zodiac, the medallion corresponding to the first month of the year represents a man with two heads, one old and the other young. At the side with the head of an old man, the arm pushes a little bearded figure into a little structure whose door closes; that is the year ended; the other had leads a little beardless figure from a little building whose door opens; this is the year commencing.

At Notre Dame of Paris on the jambs of the doorway of the Virgin on the western facade is sculptured a very beautiful zodiac, whose subjects and signs are in the best style. This zodiac dates from about 1220.

Zodiacs are often represented in painting, on the glass of rose windows of our great churches of the 12 th and 13 th cents.

Zodiacs were likewise represented on pavements. The church S. Bertin of S. Omer, that of the abbey of S. Denis, that of the abbey of Westminster, possessed and still have in part zodiacs in mosaics or in inlays of colored cements in incised slabs. Sometimes these are only the labors or representation of the occupations of the year (as at the chapel of S. Firmin at S. Denis), which replace the signs. There is a man cutting wood, another hunting, a third pruning his vine; then come the months of the fine season; a reaper, a harvester, a thresher in a barn, a vintager, etc. Sometimes in edifices of a civil character, like castles, mansions and even houses, pleasures replace the labors. Certain months are reserved for banquets, for games; persons warm themselves before a fireplace, young people plait crowns. Men hunt with falcons or nets; they fish and they dance. As today, there was then for persons of leisure a sort of regularity in the pleasures of the city and country. Certain zodiacs commence at Easter, i.e., in April (the Bull); others, for exam-



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example, that of Vezelay begins in January (Aquarius). But frequently these signs in our monuments are not in place. Being sculptured on blocks of stone before setting, on voussours or courses, the workman did not always follow the order in which they should be placed, and that order was changed.

End of 9 th Volume.





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